182.
APR 29 1929

ENGINEERING AND
MINING JOURNAL
METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

McGRAW-HILL PUBLISHING COMPANY, INC. April 27, 1929 TWENTY-FIVE CENTS PER COPY

Baldwin-Westinghouse uses Timken Bearings in Main Journals and Armatures

Down into pitchy blackness—around tortuous curves—tugging a string of ore laden cars—thrust, strain, shock, friction.

In this Baldwin-Westinghouse 15-ton mine locomotive all these things are provided for in advance by Timken Bearings in motor armatures and journals.

Then, let thrust come, let the loads mount, Timken Bearings are there with their full radial-thrust capacity, greater bearing area, their friction-free qualities, carrying the load, keeping down the cost and lengthening the life of the rolling equipment.

As an over-measure of assurance is that exclusive combination—Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric steel.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

Does Speed Mean Anything on Your Job?

The latest Ingersoll-Rand drifter drills are the fastest machines of their class and weight in the world today. In almost every test, they outdrill machines from 20 to 40 pounds heavier.

This combination of speed, lightweight, and durability — backed by Ingersoll-Rand service — produces results on any job.

These new drills are made in three sizes. Descriptive bulletins will be sent on request.

178-L.I.

Ingersoll-Rand

11 Broadway, New York, N. Y.

R-1734

Volume 127 *Number 17*

ENGINEERING AND MINING JOURNAL

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

A. W. ALLEN, *Editor*

Associate Editors: E. H. ROBIE, A. H. HUBBELL, New York. GEORGE J. YOUNG, San Francisco
Assistant Editors: W. N. P. REED, H. D. KEISER and HOMAR L. JOHNSON, New York. *Publishing Director:* H. W. CLARKE

New York, April 27, 1929

Features of E.&M.J.: V—Comment and Criticism

IN CONTRAST to the editorial pages, where the Editor says what he likes, is the department devoted to letters from readers, entitled "Comment and Criticism," where free play is allowed in the expression of ideas, whether or not they be in accord with the editorial point of view. The only requirement is that the letters be sufficiently interesting to be worth publishing, and, of course, not of a scurrilous nature, or anonymous. Every thoughtful mining engineer should contribute from time to time to this open forum, one of the most virile and generally read sections of the entire magazine, giving, as it does, the personal opinions of "the other fellow."

Contents

Editorials 665
The Evolution of Education and Mining Progress
Economic Advantages of Diesel Power Not Adequately Recognized
If Estimates Are the Fashion
An Illogical Attack on the Manganese Tariff
Art of Writing Succumbs to Demands of a Machine Age

The Beginning of Australia's Gold Mining Industry 668
As Recorded in 1852

Safety From a State Metal-Mine Inspector's Point of View 670
By M. J. McCARTHY

Systems of Mining by Caving Under Scrutiny 673

Cement Grouting Solves Serious Mine Water Problem 674
By J. S. CRAWHALL

The Diamond Industry in 1928 680
By SYDNEY H. BALL

Crucibles Developed to Resist Molten Sulphides at 1,500 Deg. C. 681

Status of the Copper Refinery Capacity Question 696

Comment and Criticism	682	Industrial Progress	687	Mining Stocks	704
By the Way	684	Mining News	690	Technical and Industrial Service Directory	33
Personal Notes	685	Market and Financial News	696	Searchlight Section	34-37
Obituaries	685	Indicators of Industrial Activity	701	What and Where to Buy	38, 40
Digest of Current Literature	686	Market Report	702	Advertising Index	42

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. McGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. McGRAW, JR., Vice-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. McGRAW, Vice-President
C. H. THOMPSON, Secretary

NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 7 S. Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Ingeniería Internacional — Food Industries
Electrical World — Electrical Merchandising
Bus Transportation — Electric Railway Journal
Construction Methods — Radio Retailing
Aviation
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

SUBSCRIPTION PRICES: United States, $6 a year. U. S. possessions, Canada, Mexico, and the countries of Central and South America, $7.50 a year. All other foreign countries, $10 a year. Single copy, 25 cents. Published weekly. Entered as second-class matter, June 20, 1879, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

CHANGE OF ADDRESS
Subscribers are requested to send both the old and the new address when they move to a new address.

Copyright 1929, by
McGraw-Hill Publishing Company, Inc.

Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

11,392 Copies Printed This Issue

Total Number of Issues to Date 3,279

HOAR SHOVELS

Hoar Shovels have again proven their superiority

In September, 1927, Patrick McGovern, Inc., general contractors of New York City, installed a Model Two Hoar Shovel for mucking in the Fifty-third Street subway tunnel. After operating this shovel for three months this contractor placed an order with us for two duplicate machines. **Three additional shovels have since been placed in operation.**

These six shovels are working in tunnels approximately 18 ft. by 20 ft., loading out large, blocky rock.

Hoar Shovels will prove equally satisfactory in your tunnel work. The smallest size shovel will operate in tunnels as small as 7 ft. by 7 ft. Our Bulletin 1824-A contains full details.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
James H. McGraw, *Chairman of the Board*
Malcolm Muir, *President*
H. C. Parmelee, *Editorial Director*

A. W. ALLEN, *Editor*

H. W. Clarke,
Publishing Director

Volume 127 — *New York, April 27, 1929* — Number 17

The Evolution of Education and Mining Progress

THE ALCHEMIST, trying to turn lead into gold, was the first metallurgist. The dowser, with forked willow wand or other forms of doodle-bug to indicate the presence of water or deposits of mineral, was the precursor of the modern, high-class, ethical, respectable, scientific, geophysical mineral surveyor, with his radio compass and plats of "equipotential." Thus did Mr. Stanly A. Easton, general manager of Bunker Hill & Sullivan, preface a notable speech recently delivered before the Board of Trade at Wallace, Idaho.

Wrong concepts of mining were not confined to our forefathers, however. Today, even, too much is expected in a short time and by the aid of minimum outlay. "The discovery, development, and mining of orebodies require not only good fortune in the first instance, but experience, capital, time, patience, and the best of judgment." Such a combination, one may add, has done much to bring the recent mineral production of Idaho far ahead of the output even in the palmiest days of the Boise Basin boom. An essential requirement to meet the competitive conditions of today and tomorrow is a technical organization of high quality, to solve the many problems inherent in the treatment of low-grade ore.

The age of adventure in mining as it used to be has passed, but the careless adventurer persists, nevertheless. Elaborate development work is undertaken, as Mr. Easton points out, without the least preliminary preparation. "A tunnel thousands of feet long and costing a fortune of wealth may be projected to cut at great depth a showing of mineral which has had little or no surface exploration, by surface cuts and prospect shafts sunk on the mineral itself, to determine its structure, extent, and probable trend in depth. Elaborate plans will be undertaken and great sums of money spent without calling in the services of the experienced consultant, geologist, or mining engineer." The average layman, unfortunately, accepts and believes almost anything he is told; and despite the fact that "excellent work is being done by our scientific societies and the technical press to disseminate honest and competent information concerning the industry, . . . the mysterious tale and the picturesque yarn seem always to fall on ready ears."

Mr. Easton commends the "bold initiative spirit," but he cautions that "it is a part of education to endeavor to guide the energy of such spirit along reasonable courses, and not permit it to be dissipated and wasted in hopeless undertakings, where it would be foreordained to disappointment and failure." He deplores, and rightly, the segregation of effort in mine prospecting, development, and production, urging a greater interchange of experience. "Our mining schools and colleges," he adds, "give opportunity such as was never known before, all the way from the four-year courses leading to a collegiate degree, to the short courses of a few days; and they are all good and helpful. Lacking opportunity for any of these educational advantages," he continues, "the publications of our engineering societies and the pages of the mining weeklies offer a wealth of information and interesting news of the great world of mining enterprises. But under all must lie a sound foundation of perfect familiarity with the basic sciences—chemistry, physics, geology, and mathematics. With these to start with, anything in the engineering of mines and metallurgy can be reached by the industrious student."

These comments carry the weight of experience and achievement, and are worthy of deep consideration by the industry as a whole. They recall to us the emphasis on the value of a personal inquisitiveness to be discerned in a letter from Dr. James Douglas to Albert R. Ledoux, published many years ago in these columns. "I made my reputation as a mining engineer and metallurgist," said Doctor Douglas, "in spite of the fact that the only scientific lectures I ever attended were in a course on chemistry when I was studying medicine. I think that the lesson of my success, such as it has been, demonstrates that great enterprises are often best controlled by managers who have a general wide technical knowledge, but who are not specialists, and who have the advantage of sound literary educational training."

Economic Advantages of Diesel Power Not Adequately Recognized

EXTENSION in the application of the Diesel engine as a primary source of power is due in large measure to its ability to use cheap fuel—crude petroleum of low grade, costing much less than the refined distillates required for other types of internal-combustion engines that operate on air that has been carbureted with fuel. The Diesel principle, on the other hand, merely involves the pumping of the fuel into the cylinder, where the air has previously been compressed. Any possibility of premature ignition, with its attendant knocking, is therefore avoided, and the high degree of compression of the air permits the attainment of an initial temperature adequate to cause ignition of the charge. Auxiliary apparatus to insure combustion is therefore unnecessary.

The foregoing remarks emphasize the simplicity of the Diesel, and simplicity is a contributing factor to over-all efficiency, which is higher in this type of engine than in the ordinary gasoline engine. Shipping companies have been quick to realize the advantages of Diesel power, and a rapid increase is seen in the proportion of new

"steamers" being equipped thus. Stationary pumps, railroad locomotives, compressors, and electrical equipment of all types are now being driven by Diesel engines, which are likely to displace the boiler and steam engine in many plants, especially where the water problem is an insistent one.

Phelps Dodge Corporation is probably the major operator of large-size Diesel engines in the United States, with a total horsepower of over 27,000. Development of these engines by this company has been noteworthy, forming significant contributions to Diesel engine design and operation. The history of the innovation was recently reviewed in these columns by Mr. C. Legrand, the corporation's consulting mechanical engineer, who stated that:

"When Phelps Dodge Corporation started using Diesel engines, operators had to be trained, and costly mistakes were often made. Most of the engines were built in this country during the war period, when it was difficult to get the materials wanted, and our present maintenance costs are still affected by these causes. Perseverance, the full co-operation of the operating forces and of the manufacturers have overcome the troubles and difficulties inherent to pioneering work. The financial results have been satisfactory, and the average cost of power, including capital charges during the whole period of operation, has been less than could have been obtained by other means of generation. The maintenance cost, instead of increasing as the plants get older, is still diminishing."

Diesel power should receive more attention from mining companies faced with the need to reduce costs, or forced to avoid the troubles incidental to boiler and steam plant operation. Especially where cheap crude oil is available, the Diesel engine should find useful application at the great majority of mining properties.

If Estimates Are the Fashion

MINING MEN in Africa are rightly proud of the new Rhodesian copper field, and when anyone underestimates its importance, they take great pains to set the erring one on the right track. Thus the *South African Mining and Engineering Journal,* on reading an estimate by a Canadian authority that places United States copper production in 1937 at 800,000 tons, and Chilean, African, and Canadian production at 300,000 tons each, points out that Union Minière alone will probably be producing 200,000 tons by that time, and that Roan Antelope and N'Kana together will probably be able to produce another 200,000 tons. This makes 400,000 tons for Africa without taking N'Changa, Mufulira, Chambesi, Bwana M'Kubwa, Kansanshi, or Namaqua into account. To us, the figure for Chile seems rather low. Production from that country was at the rate of more than 30,000 tons a month in January, 1929, although Braden output was temporarily cut in half at that time. The three leading Chilean producers have equipped capacity at present to produce more than 400,000 tons a year, with ore reserves sufficient to insure production at that rate for many years.

As a matter of fact, the Canadian estimate to which our South African contemporary took exception was rather conservative. It allowed a production in 1937 of only 1,700,000 tons of copper from the four countries mentioned. Even assuming a substantial amount, say 500,000 tons, for countries other than those included in this estimate, total production in 1937 would be placed at but 2,200,000 tons of copper, which, in view of recent developments, seems low.

The most interesting point that this discussion brings up seems to us to be the fact that the production from Africa, Chile, and Canada will all be at a comparatively low cost. This is also true of some of the American companies with large reserves.

An Illogical Attack on the Manganese Tariff

RECENTLY a circular letter attacking the existing tariff on manganese ore was issued to the press by Mr. Feodore M. Foss, assistant to the president of the Wheeling Steel Corporation, of Wheeling, W. Va. This letter, which has already appeared in various publications devoted to the steel industry, is reprinted in this issue on page 683.

A partisan attitude is of course to be expected. That Mr. Foss should espouse what he deems to be his employer's side of the manganese tariff controversy is entirely natural. Every argument has two sides, and that the proponents of each should openly defend their respective positions by all legitimate means is the essence of debate.

As an exposition of the writer's views, be they personal or vicarious, the letter is welcome. Those familiar with the facts of the domestic manganese situation and the status of the infant domestic industry, however, will be astonished by the inaccuracies and errors that characterize the statements it contains. How can Mr. Foss justify the assertion that "as far as the ferro-alloys industry is concerned, it is safe to say that manganese ore mining in the United States does not exist, and, according to very authoritative and eminent mining men and geologists, it never will exist," when at this very moment the Butte Copper & Zinc Company, which owns the Emma mine (operated by Anaconda), in Butte, is fulfilling a contract with the Domestic Manganese & Development Company, of Butte, to supply it annually with a large tonnage of manganese carbonate ore from the Emma workings; when, moreover, it is a well-known fact that large tonnages of this same ore of manganese, namely rhodochrosite, exist elsewhere in Montana and in California, awaiting exploitation; when, likewise at this very moment, the aforesaid Domestic Manganese & Development Company is ready to do business with Eastern furnaces and is prepared, despite the long overland haul, to lay down at these furnaces a nodulized manganese calcine, equal, if not superior, in analysis and in physical characteristics, to anything the furnace companies are able to import from abroad, and this at a price comparable to that which the furnaces have been paying? This fact is readily ascertainable by an investigator. How it has escaped the attention of Mr. Foss is hard to say, if he has made an investigation.

As for the latter part of the quotation from Mr. Foss's letter, strong doubt exists that "authoritative and eminent mining men and geologists" will assert today that a domestic manganese industry never will exist.

Evidently Mr. Foss is depending too largely on the joint report (now five years old) of the two mining engineering societies, oblivious of the fact that it needs revision.

One swallow, of course, does not make a summer. One manganese enterprise would hardly constitute an "industry" for which protection could plausibly be demanded. But the domestic industry is by no means limited to a single venture. Other manganese mining enterprises of varying degrees of importance and in varying stages of development are already under way. If Mr. Foss desires information as to their whereabouts, the American Manganese Producers Association, whose headquarters are in the Metropolitan Bank Building, in Washington, D. C., will be glad to furnish it.

Mr. Foss makes capital of the fact that in the more than six years in which the manganese tariff has been in effect, the domestic production has been small. His attention is invited to the following: First, the mere passage of the Tariff Act of 1922 could not forthwith create a domestic industry. The industry had to grow. Capital had to be persuaded into embarking on the venture, and capital has been all too cognizant of the possibility that the tariff might be removed. Consumers, moreover, have seemed reluctant to use the domestic product, even where it met their requirements as to grade and tonnage. Herein is the principal reason why the production in 1928 did not show a large increase over that of the year before. If domestic consumers—namely, the ferromanganese manufacturers—continue to decline to deal with the producers or would-be producers of domestic ore, they will of course hold down the domestic output for a time. They should hesitate, however, thereupon to ask Congress to remove the tariff on domestic ore on the ground that it is ineffectual. The result of such continued refusal, moreover, may conceivably be to force some of the domestic producers into the business of making ferromanganese. Indeed, this would seem to be the proper objective of the well-financed domestic manganese mining enterprise.

In the light of the foregoing, Mr. Foss's further statement that the manganese ore industry in the United States is limited to the production of low-grade ferruginous manganese ores is seen to be misleading. A large tonnage of low-grade manganiferous iron ores is indeed being mined annually in Minnesota, because by blending ores of different grades a product usable at the furnaces for purposes other than that of making ferro can readily be obtained. Advocates of the *raison d'être* of the domestic industry, however, are content to ignore this output, regarding as they do these low-grade ores of the Lake Superior region only as a vast store of manganese, locked up for the moment in a form unsuitable for making ferro, but which can presently be made to yield its manganese through the agency of leaching, or, by improved metallurgical methods, can be converted directly by smelting into ferromanganese.

Acquisition of a "stockpile" of manganese by the government as a war-preparedness measure is advocated in conclusion by Mr. Foss. This recommendation was originally made in the joint report of the mining societies referred to. Moreover, it has been seconded in these columns, with the added proviso that domestic ores of proper grade be given first consideration in making the necessary purchases. However, the need for a "stockpile" is apparently no longer as urgent as it seemed some eighteen months ago. The domestic industry, in the present stage of its development, would undoubtedly be able to take care of war-time needs, if properly protected.

Mr. Foss apparently has formed the opinion he expresses by theorizing from premises laid down by others which have since proved to be incorrect. He is respectfully urged to get out into the field and acquire facts. Study of the research that has been conducted with the objective of rendering the country's large reserve of low-grade manganese useful to the steel industry is also recommended. Such personal investigation will surely convince him of the unsoundness of his argument.

Art of Writing Succumbs to Demands of a Machine Age

STRANGE as it may seem to most, the pen-written business communication or contribution for publication is not a thing of the past, despite the universal acceptance of the typewriter. Schools and universities would do well to include a short course in typewriting in their curricula for all would-be mining engineers.

An ability to typewrite quickly and accurately may be essential to the success of an undertaking, for the mining engineer is often situated so that he himself must constitute his own office force. The typewritten letter obtains precedence over the pen-written letter, and commands a degree of respectful consideration that the latter cannot hope to achieve, especially in this age of careless chirography. The typewriting of a thesis or a report gives added prestige to the effort. It compels the writer's attention, by the avoidance of distraction, to the method of presentation, to the phraseology used, to the possibility of condensing conclusions and the more orderly classification of ideas. It permits intelligent anticipation as to how the effort will appear in print, and leads to a greater degree of revision, usually badly needed.

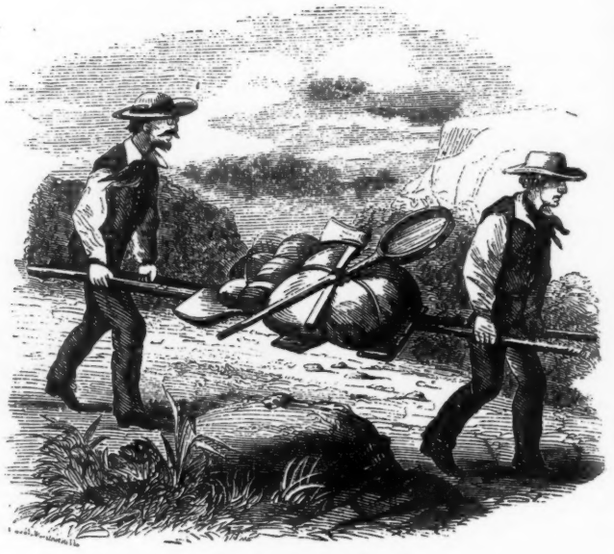
However, to get the best out of a typewriter necessitates proficiency in operation, and this means proper schooling in the first instance. The graduate usually purchases a portable machine, which he finds he can operate by the use of only 20 per cent of the digits provided by nature. When he has acquired a proficiency thus, he is proof against the acquisition of a proper style. A combination of speed and accuracy is a difficult goal after much time has been spent in operating the machine by amateur methods. If the elements of successful typewriting have not been acquired at school, the emerging graduate can teach himself, even with the portable or traveling machine, by means of instruction books and charts; but perseverance is needed.

The young engineer who has mastered an efficient system of typewriting will find that he has the advantage over his less proficient colleagues. His letters and reports, even from prospects and mining camps, will demand and receive early attention and maximum consideration. The ability to typewrite permits the orderly keeping of duplicates and records and correspondence.

Carefully typewritten articles or reports will always attract favorable attention. The young mining engineer who will accept this fact is several steps ahead of a competitor who is obliged to wait until he returns to civilization and office facilities before he can begin to capitalize on his experience and travels.

The Beginning of Australia's Gold Mining Industry

As Recorded in 1852



GOING PROSPECTING

EXPERIENCE gained by one of the participants in the California gold rush of '49 was apparently responsible for the initial development of the gold-mining industry of Australia. This fact and many other circumstances of unusual interest are presented in the following excerpt taken from an article entitled "Australia and Its Gold," by Alfred H. Guernsey, that appeared in the December, 1852, issue of *Harper's New Monthly Magazine*. Several illustrations published with the article are reproduced, together with the captions appearing with them.

"Among those persons whom the gold fields of California had attracted from Sydney was Edward Hargraves. He returned to Sydney with little gold, but with some valuable experience; and immediately began a series of explorations at home. On the third of April, 1851, he made a communication to government, stating that, as the result of two months' search, he had discovered valuable deposits of gold, which he offered to make public for a consideration. To this offer an answer was returned that if the disclosure should prove valuable, the discoverer should be liberally rewarded. Mr. Hargraves accepted the proposition of government, and proceeded to the places which he designated, in company with the government geologist. The first place where search was made was at Summerhill Creek, near the town of Bathurst, on the western side of the mountains, 150 miles from Sydney.

ROCKING THE CRADLE

"Early in May the discovery began to be bruited abroad, and by the 19th of that month hundreds of persons were digging at Summerhill Creek, to which they gave the name of Ophir. Three days after this, the government issued a proclamation claiming as the property of the Crown all gold found in its natural place of deposit, whether on public or private lands; forbidding all persons to dig or search for gold on Crown lands, without previously procuring a license; and settling the amount of the 'royalty' to be paid by those obtaining gold on their own lands.

"By the first of June the current had set strongly toward the gold diggings. Sydney assumed a new aspect. Blue and red woolen shirts and California hats became the show-goods in the fashionable streets; from the stock of cradles displayed for sale, a stranger would gain an alarming impression as to the sudden increase of the infantile population of the colony. Waterproof tents, quicksilver for amalgamating gold soil, preserved provisions, spring-carts for the diggings, cradles and prospecting pans, became the leading features of newspaper advertisements. The booksellers found their trade limited to 'Digger's Hand-books' and 'Gold-digger's Guides.' Conversation took a golden turn: 'Have you been to the diggings?' 'Are you going?' 'Have your servants gone yet?' were the standing questions. The sudden in-

trusion of gold disturbed society as much as the obtrusion of the igneous gold-bearing quartz had long ago disturbed the quiet aqueous rocks. The man inured to toil, for a time at least, was the equal of any one. Tradesmen, mechanics, and servants, who a week before had stood cap in hand before their employers and masters, now 'flashed their independence' in their faces. Everybody who could go to the mines prepared to do so. The rugged defiles of the Blue Mountains were crowded with drays and ox-carts, piled with stores and mining utensils, and escorted by long lines of travelers on horseback or a-foot, all in search of the new Ophir.

GOLD DIGGING IN AUSTRALIA

"It was soon discovered that gold-mining was no child's play. The work was of the hardest a man can perform, the fare of the roughest, and the company with whom the miner found himself none of the most select. To dwell in tents was hardly as poetic as it had seemed when contemplated at a distance. Nuggets were like 'angel's visits, few and far between.' Rocking the cradle was quite a different thing from the same interesting performance at home. To breakfast at daybreak in a tent or gunyah crowded with a mass of unwashed human beings in calico shirts, then work till mid-day in the water, snatch at noon a hasty meal of mutton, damper, and Bush tea, without even stopping for ablution, and back to the mines till dark, was something that many had not bargained for. Besides, fortunes were not to be made in a day. Of the thousands at the mines, the government commissioner reported that about two-fifths were making five dollars a day; about the same proportion gained from fifty cents to a dollar and a half; and the remainder earned nothing. By the first of July—the Australian mid-winter—a reaction had taken place. The weather grew cold and stormy; the river was flooded, so that no work could be carried on at the 'wet-diggings,' and the miners were reduced to the alternative of lying idle, or going prospecting in search of 'dry-diggings,' carrying their implements and stores as best they might. Many sold their implements and stores for a trifle, and made their way homeward, pursued by the jeers of the passers-by, and met everywhere by the taunting question, 'Have you sold your cradle?'"

The discoveries of gold in New South Wales were soon thrown into the shade by still more astounding discoveries in the Colony of Victoria, made about six weeks later. Here were the famous diggings of Ballarat —famous for a few weeks, that is, till they were eclipsed by the still more famous ones of Mount Alexander. The deposits here were of richness unexampled. The Governor of the colony once saw eight pounds' weight —two thousand dollars' worth— washed from a couple of pansful of clay. In a fortnight after the discovery of the Ballarat diggings Melbourne was deserted. The mechanic left his work bench, the carman his team, the servant his knives and forks, for the diggings. The tradesmen and merchants were forced to follow—for what was the use of their staying when their customers were gone? What an overturn there was! How gold levels distinctions! A flannel shirt, California hat, and unshorn chin became emblems of nobility, and took front rank everywhere. A sad case was it for poor helpless mortals who had been accustomed to be waited upon.

Twenty thousand—thirty thousand—forty thousand diggers were vibrating from Ballarat to Mount Alexander, from Mount Alexander to Bendigo Creek, from Bendigo Creek to Fryar's Creek. All had heard of extraordinary yields—of gold by the pound, of nuggets by the quart; but when the first excitement was over it was seen that few had met with any such luck. One by one the disappointed diggers slunk back to their former posts.

DINNER AT THE DIGGINGS

SAFETY

From a State Metal-Mine Inspector's Point of View

Co-operation of Company Officials in Observing Mining Laws Important in Avoiding Accidents

COMMON SENSE and co-operation are among the fundamental principles which should be followed in all safety work. If officials in charge of mines, mills, and smelters will co-operate with inspectors in observing state mining laws, safety will generally result. Opinions of operators and their officials should be sought when preparing recommendations regarding safety rules. For an inspector to issue positive orders to any official on a property without first consulting with him as to the best method of applying that particular order or recommendation would be unfair. The official's judgment is often equally as good as that of the inspector. An inspector will often order a guard rail or a shield installed that may be a hindrance to the operation of a particular machine. The same might apply to similar orders issued underground.

NEITHER economy nor efficiency is possible without safety. Every safety device pays dividends. . . . If officials in charge of mines, mills, and smelters will co-operate with inspectors in observing state mining laws, safety will generally result. . . . Opinions of operators should be sought when preparing recommendations regarding safety rules.

I asked Mr. Robert Gardiner, superintendent of the Cresson mine, to give me some of his ideas regarding safety measures, inasmuch as he has supervision over all work at the Cresson property. The following are extracts from his letter:

"I still believe that the old commonplace precautions, as taught by those who have mined most of their lives to those who intend to make mining a business, the most valuable of all the safety measures, with the possible exception of the knowledge of the nature of mine gases, electricity, and the strengths and strains of metals. Some accidents are difficult to foresee, but it is more important to know what accidents are likely to occur. Such knowledge is necessary if proper action is to be taken when an emergency arises.

"Gold mines are not often alike, and it is difficult, therefore, to outline a system of safety which would be applicable in any two cases. Moreover, as they are usually of a temporary nature, it is often necessary to stretch a point of safety in order that they may even operate. This is one of the hardest problems for the safety engineer. There are, however, certain features of a mine, such as a shaft, that should never be neglected. Hoisting engines, cables, cages, and shaft should be examined and inspected regularly by persons competent to discover and judge a defect. In this connection, I desire to stress the importance of understanding strains and fatigue of irons and steels. These cause many serious accidents. When one member of an assembly has failed from such a cause, a similar condition is likely to occur in another member.

"As a general safety measure, all material of any kind near a shaft should be arranged so as to prevent any chance of its being pushed into the shaft; carelessness or ignorance in respect to this matter is a frequent cause of accident. Mine bell pulls should be properly protected and labeled. No level flash switches should be similar in action or appearance to the switch or pull that operates the mine bell. One of the most common accidents in gold mines is that of trammers having fingers crushed between the wall and car bodies. This applies especially to new men. Common mine knowledge is necessary to prevent such injuries, but owing to the large turnover of workmen I can't tell how we shall ever be able to avoid this class of accident. Most of these men belong in another industry, and are in the gold mines only as an expedient. Among this class of men the accident rate is high; they comprise about 60 per cent of all those injured. These accidents are due mostly to want of mine experience."

To prevent accidents of the type mentioned above, sufficient lights should be provided throughout all levels where mining work is being carried on. Quoting Mr. Gardiner again:

"Most experienced miners know when the roof or back of a stope or other working place is unsafe, but rather than take the time or make the effort to bar the loose rock down, they often try to dodge or work around the dangerous place. When the rock does fall, they are not quick enough, or are too confused, to get out of the way. In cases of this kind a mine boss should insist on men taking time to make working places safe to a reasonable degree. In this connection I might state that contract systems have contributed to the careless attitude of the men, as under such systems men will take risks no company wishes anyone to take. This has been the

A paper presented at the First Rocky Mountain Safety Conference by M. J. McCarthy, state mine inspector, District No. 2, Colorado.

indirect cause of a great many accidents, according to my personal observation."

The following suggestion of Mr. Fred Jones, of the Stratton Lease, may be the means of preventing such accidents as those mentioned above:

"There is one safety measure which could be enforced by every mine at little cost to the men, and that is the compulsory wearing of hard-boiled hats or caps. Such measures in the Cripple Creek district alone would have prevented hundreds of scalp wounds and a number of deaths. Some of these hats are being worn in the district now, and several mines in Arizona do not allow a man without one underground."

Other suggestions offered by Mr. Jones follow:

"Electric blasting in wet places and places difficult to get out of cannot be emphasized too much. The state law should require electric blasting in all winzes and shafts. After all is said and done, the most important safety measure is to impress on the men the necessity of being careful. Without a doubt, the majority of accidents are due to the carelessness of the injured. There should be a disposition on the part of the bosses at all times to warn the men of the consequences of carelessness.

"For the prevention of fire and the fighting thereof underground, nothing seems so important to me as having water available and doors to control the draft. The Stratton's Independence shaft would have been entirely destroyed had we not had doors to close, which action practically smothered the fire. Every mine which contains a great deal of timber should have a mine watchman to look for fire after the shift has gone home. The danger from cigarettes and cigars cannot be overestimated. Where it is possible, every district should have mine rescue apparatus of some kind."

The subject of preventing mine fires should be given further consideration. The following ideas have proved worthy of use in mines without adequate fire protection:

All tunnels covered with inflammable buildings should be provided with fireproof doors placed in a cement frame at a distance of approximately 50 ft. from the portal, the door to be arranged so that it can be held open by a small hemp rope extending from the door to the building over the portal. When the rope is either cut or burned off, the door should close automatically. At a point inside of this door the adit tunnel should be driven to the surface, so that in case of fire to the building the adit levels could be used as an escape-way for men working in the mine.

All shafts equipped with buildings and machinery, with only the working shaft for exit, should be divided into at least two compartments, one of which should be tightly partitioned off and used as a ladderway. The ladderway should be securely bulkheaded at a point at least 25 ft. below the collar of the shaft, and below this bulkhead a drift should be run to the surface if location of shaft is on a side hill; otherwise a drift should be run to a safe distance beyond the walls of the building and from there upraised to the surface. Ladderway and landing should be kept at all times in good repair, so as to afford an easy means of escape in case of fire. All such shafts should be cemented from the collar to the bottom of the bulkhead.

At all places, where practicable, no building should be allowed within 50 ft. of the collar of the shaft or portal of a tunnel.

Many of the foregoing suggestions are contained in sections 3411, 3415, and 3416 of the complete statutes of Colorado, 1921.

All mines and mills employing 50 or more men should be provided with a first-class water system and hose, and also a good supply of mechanical fire extinguishers. These should be distributed throughout the buildings and at places in the mines where a large amount of timber is used.

All exits leading out of mines, mills, and smelters should be kept in good repair and should be readily accessible at all times to employees in case of fire in the buildings or mine timber.

All mines employing 25 or more men should have at least two ways of escape.

All safety overwinding devices, such as the Humble and Akron hooks or the Welch hoisting engine controller, should be used on all first-motion hoists. These were recommended by the inspector on the cables and hoist at the mine of Stratton's Independence, Ltd., two weeks prior to Jan. 27, 1904, when fifteen men were killed on the cage. Had the order been complied with, the lives of the fifteen men would have been saved. Later, the Portland Gold Mining Company complied with a similar order, and the day after the adoption of the Humble detaching hooks, the cage, with fourteen men, was pulled into the cutoff, and the mens' lives were saved by the action of the hooks catching promptly and holding the cage in the headframe, while the end of the cable was drawn almost into the engine room. Automatic chairs should be employed at the collar of all shafts where skips and cages are used.

Neither economy nor efficiency is possible without safety. Every safety device pays dividends. When an operator or mine owner is protecting the life and interest of his employees, he is also protecting the interests of his company.

The following safety suggestions are worthy of consideration:

1. Overwinding device: Either the Humble or Akron detaching hook should be used on all cables in vertical shafts.

2. Proper safety clutches should be used on all cages and skips.

3. All hoisting engines used for the hoisting and lowering of men, with a speed of 800 ft. or more per minute, should be equipped with a Welch hoisting engine controller or its equivalent.

4. Automatic chairs should be placed at the regulation point in all headframes where cages and skips are used. A platform and railing should be installed at the same point.

5. Solid doors should be placed at the collar of shafts and at all level stations, instead of guard rails; they should be set back 2 ft. from the shaft opening.

6. Closed partitions of shaft compartments should be maintained on all level stations and shafts where the air is bad.

7. All worked-out stopes should be filled with waste rock.

8. All open holes should be covered or surrounded with guard rails.

9. A well-maintained and safe ladderway with landings every 20 ft. should be employed in all manways leading into and out of all parts of mines and through stopes between levels.

10. Sufficient ventilation for all men in all parts of the mine should be provided.

11. All belts, pulleys, cranks, ends of motor shafts, emery wheels, gearing of machinery, and line shafts should be securely safeguarded in all mills, engine rooms, machine shops, and smelters.

12. A safe bulkhead should be placed over men working in the bottom of shafts, when hoisting is being carried on in the shaft to the surface, or sinking is being done in the shaft. This precaution should also be taken in sinking winzes and in operating underhand stopes. In a shaft 300 ft. or more deep a substantial trap door should be installed in the hoisting compartment, so that it can be opened and closed by men working in the bottom of the shaft. Only experienced shaftmen should be employed on such work.

13. The majority of accidents in all mines are caused by falling rock. Be absolutely sure that there are no loose boulders on the sides or top of working places. If the ground appears to a workman that it would cave, he should call a shift boss and show it to him, if he cannot pick it down himself.

14. Capable and experienced engineers should be employed on all hoisting engines where men are hoisted or lowered.

15. An efficient system of electric bells, flash lights, and pull bells should be installed in all shafts 300 ft. or more in depth on properties where drifting and stoping are being done. A telephone should be installed on all level stations wherever possible.

16. Sufficient timber should be furnished all employees underground, and wherever needed.

17. Sufficient water and hose for fire protection in all mills, shafthouses, and smelters should be provided. Water should be used for laying dust in all such places, and in mines where 25 or more men are employed.

18. All machine drills, drifters, stopers, and jackhammers should be equipped with water attachments.

19. All high-tension electric wires should be safeguarded, and should not pass within 50 ft. of, or over, any mine building.

20. Automatic trap doors should be placed on all shaft collars when sinking is in progress, and a bucket dumper should be employed whose duty should be to see that the doors are closed immediately after the bucket passes through the collar of the shaft.

21. Mine maps showing all exits from all parts of the mine should be made of all mine workings and kept up to date.

22. Cables should be examined daily and repaired when necessary. They should be cut off when six or more wires are broken in any one strand, or the cable should be replaced with a new cable, especially when the cable is crystallized, or when corrosion is exceptionally severe.

23. Automatic trap doors should be used at the collar of all winzes, as well as on shafts, when sinking is going on, regardless of the depth of the winze or shaft.

24. Cagers and skippers should be employed where cages and skips are used and where hoisting is done from two or more levels.

25. Cars, skips, and buckets should not be filled to overflow with muck, when the muck is being hauled to the surface.

26. All crossheads should be provided with a safety appliance so constructed that the crossheads cannot stick in the shaft without also stopping the bucket. Floating crossheads should not be allowed.

27. Copies of the state signal code should be posted in the engine room, at the collar of the shaft or winze, and on each level station.

28. Electric lights should be provided on all level stations and at other places where needed underground, and also in all cellars, pits, and other dark places in mills and smelters.

29. Regulation ladders should not have rungs more than 12 in. apart, and the sides should not be less than 2x4 in.

30. Change rooms with suitable lockers, wash bowls, and shower baths should be provided at all the larger mines, mills, and smelters.

31. Cable fastenings: Sockets and clamp fastenings are used. In metal mines the clamp fastening is most generally used because it is more readily put on and considered safer; it should be adopted.

32. All storage magazines should be placed at a safe distance from all working shafts, pits, and buildings; the American table of distance should be used as a guide. Electric wires or lights of any kind except a flash light should not be allowed inside the door of a magazine where dynamite, black powder, or caps are stored. Taking any open light into a magazine should be forbidden. Steel tracks or pipe lines should not be extended beyond the magazine door. Cases containing explosives should not be opened in the magazine, and only implements of wood, brass, or copper should be used in opening the cases. Some person should be designated by the company to have charge of the magazine and carry the key, as the door of the magazine should be kept locked at all times, except when powder is being put into the magazine or taken out. *Blasting caps should never be kept with powder while in storage or delivery.*

33. When it is necessary to thaw dynamite, a suitable powder thawer should be used and placed at a safe distance from all working shafts, buildings, and places where men are working. If kept underground, it should be at a safe distance from all main traveled drifts and levels. More than 24 hours' supply should never be put in the thawer at any one time.

34. A notice stating the number of men allowed to ride on a cage, skip, or bucket at any one time should be posted at the collar of the shaft and at all level stations.

35. Wood or inflammable buildings should never be placed over the collar of shafts or at the portal of tunnels where the lives of men underground may thereby be endangered.

36. All open shafts, pits, and other excavations on the surface should be securely covered or fenced.

37. Men should never be hoisted or lowered through any shaft faster than 800 ft. per minute on a cage or skip, and on a bucket no faster than 300 to 500 ft. per minute, depending on the condition of the shaft.

38. The sheave axle should be adequately strong, and the sheaves properly mounted and frequently inspected by master mechanics or by other competent persons.

39. All operators should have all working places and equipment made safe before proceeding with regular work.

40. Carelessness, absent-mindedness, and inexperience are the usual causes of preventable accidents. It should always be remembered that carelessness on the part of any employee not only endangers his own safety, but also the safety of his fellow workmen.

41. No person under the influence of liquor or in the possession of liquor should be permitted to go to work, and it should be the duty of the foreman to instantly discharge any man coming to work under the influence of liquor.

42. Foremen and shift bosses should not allow fooling, skylarking, or scuffling around moving machinery or any part of the plant or underground.

43. Employees not familiar with electrical devices, or not properly authorized by the chief electrician, should be forbidden to work or tamper with any electrical wires or machinery.

44. While underground, workmen should not, under any circumstances, try to walk or move around without a light. If a workman loses his light and cannot re-light it, he should stay where he is until he can attract attention.

45. A double-pointed bar should not be used in loading at the chutes. A bar which is blunt on one end should be furnished.

46. When muck hangs up in a chute and cannot be barred down from the track level, the shift boss should be notified. Workmen should never enter a chute from the bottom unless they are sure it is empty.

47. No one should ever go underground in a metal mine without a good supply of matches.

48. All operators should have a suitable first-aid kit available.

49. When a carbide can is emptied of all carbide it should be filled with water before it is used for any other purpose. Only a day's supply of carbide for each man should be taken underground.

50. Do not talk to an engineer at any time while he is operating a hoisting engine.

51. Safety goggles should be worn by workmen at all times when necessary, or when requested by the foreman or other person in charge of work.

52. Men should wear spats and safety goggles when working on furnaces or dipping molten metal.

53. All bag-room men should wear respirators.

54. All safety guards should be replaced after a repair job is finished.

A List of Don'ts Regarding Explosives

1. Do not forget that you are handling explosives.
2. Do not smoke while handling explosives.
3. Do not carry blasting caps in your pocket.
4. Do not tap or otherwise investigate a cap.
5. Do not take caps out of a box by prying it with a nail, wire, candlestick, or other metal object.
6. Do not draw wires from electric caps.
7. Do not crimp caps with teeth or knife.
8. Do not reload a hole until it has cooled off.
9. Do not force a primer into a hole.
10. Do not tamp a charge with iron or steel bars.
11. Do not bend a cold fuse, as it will break.
12. Do not use a fuse that is too short.
13. Do not spit a fuse until you are sure that everything is clear and that no one will be injured by the blast.
14. Do not fail to count the explosions.
15. Do not enter the working place for 30 min. after you know that a hole has missed. It may hang fire.
16. Do not drill, bore, or pick a missed hole. If you cannot put in a new primer and explode the hole, drill and blast a new hole at least 2 ft. away.
17. Report all misfires to the shift boss.
18. Do not forget to use an extra light in a safe place when spitting your fuse.
19. If powder catches fire, do not attempt to put it out. Warn everybody and get out.
20. No man should spit more than fifteen fuses at one time. If there are more than fifteen fuses, get an assistant.
21. Never use a candlestick or other metal object to make a hole in the powder.

Other Don'ts

22. Do not oil machinery while it is in motion.
23. Do not forget to carry compensation insurance at all times.

The foregoing items are important, but they comprise only a few of the safety suggestions and don'ts in regard to mining.

Systems of Mining by Caving Under Scrutiny

A STUDY of the caving system of mining as employed in Arizona is now under way. The following comments regarding the study are made by the U. S. Bureau of Mines, which is actively conducting the investigation at its Southwest Experiment Station, Tucson, Ariz.:

Bodies of copper ore suitable for mining by a caving method are generally of the disseminated type. It is desirable that the ore mass contain sufficient fractures, or be of such a texture, that the rock will break in relatively small fragments in caving. Large, hard blocks of ore increase the cost of mining by a caving method and may make this system uneconomical.

The mineral constituents are also an important factor to be considered in mining an orebody by a caving method. Minerals that cause the ground to swell on exposure to air or moisture, or minerals that cause the broken ore to stick in chutes, are particularly undesirable in mining by a caving system. An excessive amount of such minerals as kaolin or talc in an orebody may make inadvisable the selection of a caving method of mining. Only well-drained orebodies should be mined by a caving system, as excessive moisture increases the cost.

In mining by a caving method the last of the ore in a block may not be drawn until a year or more after it is broken; therefore, it is desirable that the orebody does not contain minerals that will oxidize, or promote oxidation of the valuable minerals in cases where the ore mined is treated by flotation. For instance, pyrite oxidizes rather readily and on oxidizing produces sulphuric acid and ferric sulphate, which attack chalcocite and bornite. At an Arizona copper mine a block of ore that had been undercut and caved was allowed to stand for about a year. On drawing later, it was found that part of the copper was in the acid-soluble form, which caused difficulties in the concentrator and increased the losses in the tailing. This particular block had a relatively large amount of pyrite associated with the copper sulphide minerals.

Cement Grouting

Solves Serious Mine

THE BIRMINGHAM DISTRICT of Alabama produces about 10 per cent of all the iron ore mined in the United States, about 80 per cent of the Birmingham production being "red ore" from the enormous deposits of Red Mountain, which will serve as a supply for many generations. Most of the ore, which averages about 36 per cent metallic iron and 17 per cent lime, with only 0.3 per cent sulphur and no phosphorus, is mined by slopes from the outcrop, but the time is rapidly approaching when economic considerations will compel many operators to sink shafts to reduce haulage and excessive pumping charges.

Geologically, the red ore occurs in the Clinton formation, consisting of 200 to 300 ft. of sandstone and shales mainly, in the Silurian system, the most important deposit, both as regards tonnage and quality, being the Big Seam. This is from 16 to 20 ft. thick, but is divided by a bed of shale which varies from a mere separation to 2 ft. in thickness.

Most of the property in this area had been acquired by other interests when the Gulf States Steel Company, as a source for its future ore supplies, purchased the Shannon property, lying a long way from the dip of existing workings, and therefore having a greatly increased thickness of superincumbent strata. Subsequent to proving the area by diamond drilling, the former owners of this property had already begun sinking a 9x18 ft. slope in Shades Valley at an inclination of 52 deg. prior to the time of the transfer, so the new owners were thereby committed in a measure to a continuance of the development scheme. By 1920, the slope had cut the Big Seam at a vertical depth of 2,100 ft. and concrete lining had been placed in readiness for ore raising.

Development operations necessitated some experiment-

THE AUTHOR OF THIS ARTICLE *is a member of the engineering staff of the François Cementation Company, Ltd., of London. He recently returned to the United States from Nova Scotia, where the method described herewith was used successfully to dry a shaft that had hitherto defied local efforts. In addition, a 4-in. diameter drillhole was bored at another mine vertically upward for 400 ft., to tap inundated workings, against a pressure of 560 lb. per sq.in. In both instances the results indicated the application of a satisfactory technique in handling such problems*

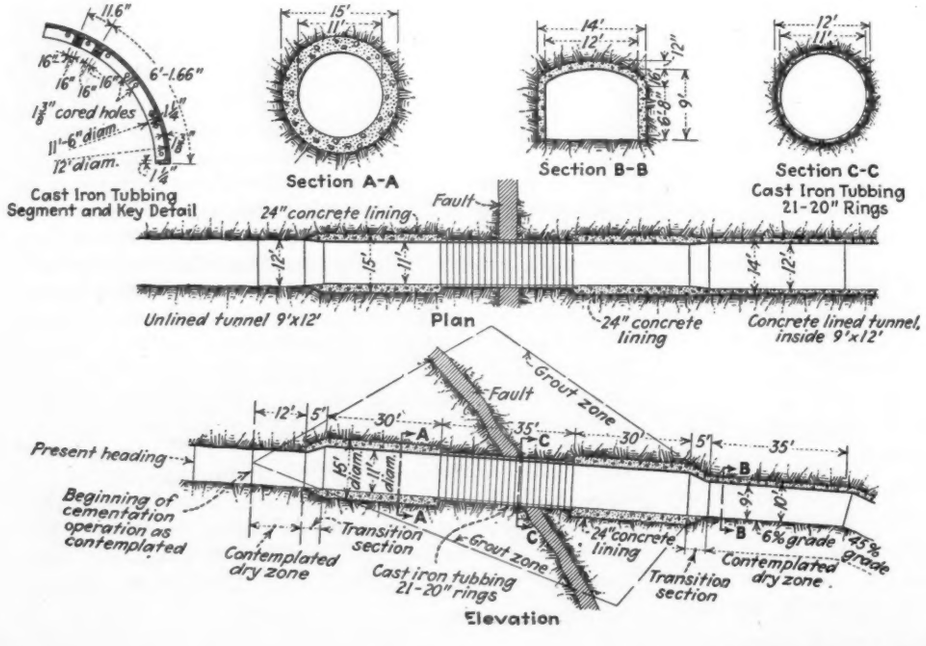


Fig. 1 Proposed construction through fault zone

François cementation process, developed in Europe, finds useful application in the Americas. . . A record of operations at the Shannon mine of the Gulf States Steel Company

Water Problem

. . . By J. S. CRAWHALL

ing with various methods of working to ascertain the system that would give the best control of roof weight at such a depth, but eventually a sound scheme was devised, so until March, 1925, mine development proceeded normally. The general layout of the mine is shown in Fig. 3, which shows the main haulage slopes driven generally to the full dip. Chambers are driven 30 ft. wide along the strike, and as a first process the lower 9 ft. of ore is extracted, whereas at a later date the upper 9 ft. is shot down, no attempt being made to remove the pillars, an operation which will not take place for many years.

Ample evidence, from geological records, showed that a fault having a displacement of about 200 ft. existed on the Shannon property, and indeed this was crossed without meeting water in the main hoisting slope. By March, 1925, however, Slope "A," which had been showing evidence by roof seepage of water proximity, struck about 40 g.p.m. in the face. Diamond-drill holes were then advanced in Slopes "A," "B," and "C," all of which proved the existence of a water-bearing fault, which carried limestone into juxtaposition with the Big Seam, as shown in Fig. 4, which is a section of the plan given in Fig. 3.

Cement grouting operations were begun by the owners to seal off this water and later assigned to an eastern firm of contractors, involving much time and expense; but all to no purpose. The reasons for failure are mainly ascribed to the proximity of Slope "A" to the fault and the shattered nature of the ground, together with lack of experience in dealing with underground water problems and insufficiency of plant and methods.

The characteristics of the problem may be stated as follows:

1. The registered gage pressure of the water in Slope "B" was not less than 950 lb. per square inch.
2. When a number of drill holes in Slope "A" were open simultaneously, about 100 g.p.m. flowed and the pressure dropped considerably.
3. Heavy flows of pyritic mud and pebbles totaling several tons rushed out of the boreholes at intervals, accompanied by hydrogen sulphide gas.
4. The fault proper varied between 4 and 8 ft. in thickness.

Originally, the owners had fully considered driving through the fault with the aid of pumps, but partly owing to the limitations of their main slope to accommodate pump columns, and more particularly because of the fear of a severe flow of water and mud, and its attendant danger of indefinite caving, they felt that a pumping scheme was not feasible. So serious at this stage was the problem that the only real solution appeared to lie in sinking another shaft on the property beyond the fault, a procedure which would cost at least $1,500,000, owing to the rise of the surface over Shades Mountain,

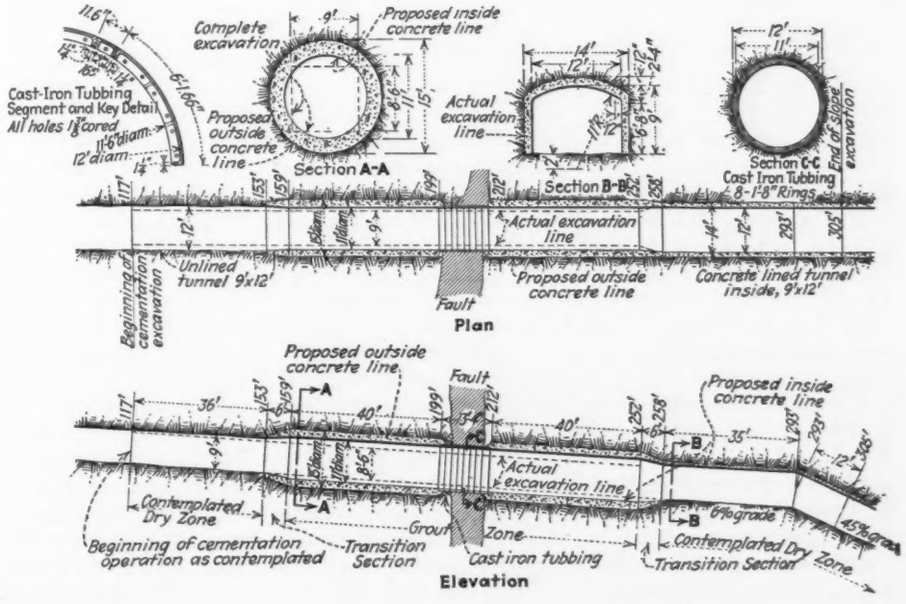


Fig. 2

Amended proposed construction through fault zone

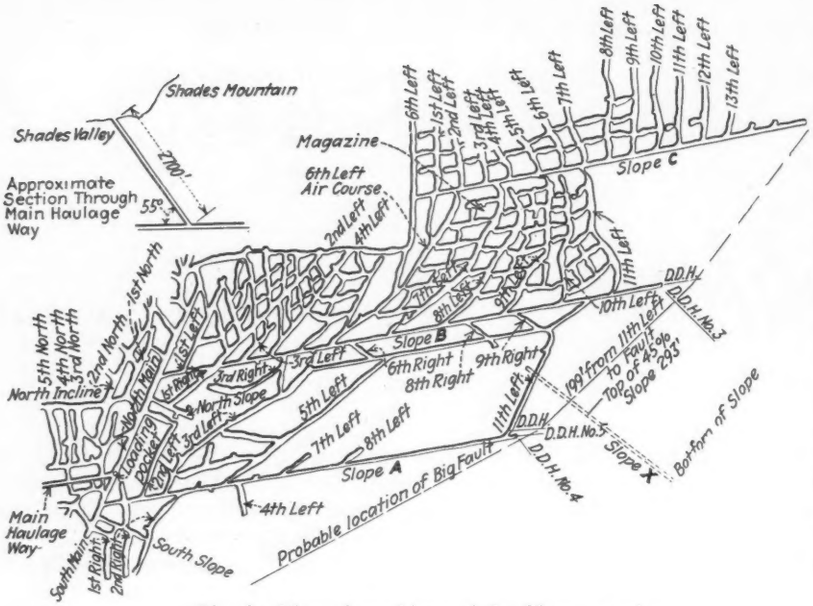


Fig. 3—Plan of workings of the Shannon mine

the attendant construction of a railway, and other related factors.

The Dravo Contracting Company, of Pittsburgh, had on many occasions encountered water difficulties in shaft sinking, notably in 1924, when that company sank a new shaft for the International Salt Company at Detroit, in which operation five men were killed through a heavy influx of water and gas. This experience, with the attendant enormous cost of the operations, led the company's engineers to investigate the work carried on by the François Cementation Company, of London, in the British, European, and South African mines, and in addition one of the mine managers of the Gulf States Steel Company had inspected some of the jobs carried out by cementation in Britain.

As a result of these investigations the Dravo company entered into an arrangement with the François company for the American rights to use the patents and plant of the last-named company, and engaged the services of a nucleus staff of engineers and foremen for the prosecution of work in America similar to that developed in Britain.

Development of François Cementation Process

Cement grouting has been carried on by engineers for more than half a century, but it was only in the early part of the present century that it began to be recognized as a competitive method for shaft sinking through water-bearing ground. In 1911, M. Albert François, after carrying out a number of contracts in the coal fields of northern France and Belgium, introduced his methods into England. The early reverses which he suffered led to the ultimate perfection and success of the process, until it is at present recognized as the safest, cheapest, and most speedy method of shaft sinking in any water-bearing ground other than boiling quicksand.

Liquid cement grout, instead of being blown intermittently by direct air pressure and in thick soupy form, is pumped into the rock through boreholes in a steady stream by machines that will develop pressures of 3,000 lb. per square inch if required. The grout is of exceedingly thin consistency at the beginning of the injection operation, but is gradually thickened as the pressure will allow. Thus it is found that in normal clean fissured rock the very finest hair-like cracks are completely filled with solid cement, the excess water in the grout being forced out of it by the action of filtration. Whenever rock, owing to its fine fissuration, sand filling of the fissures, pores, or other causes, does not accept liquid cement readily, it is treated by chemicals to make it more tractable, experiments showing that only one-quarter to one-sixth of the pressure is needed to drive in the subsequent cement filling. Under a patented process, silicate of soda and sulphate of aluminum are injected as two independent clear solutions; they meet in the rock, forming a colloidal precipitate which lubricates the fissures with a jelly-like substance. That, under pressure, also has its excess water squeezed out, and thus, along with the cement which has followed, it sets and forms a complete water-tight filling. To realize these high pressures, pumps, hoses, and accessory plant have necessarily had to be developed which will bring about the desired results in the speediest and most efficient manner.

Apart from the extensive record of successful work in mining operations, civil engineers have utilized the cementation process in such work as pretreating the rock of the new Mersey Vehicular Tunnel—44 ft. in diameter—now under construction under the River Mersey between Liverpool and Birkenhead; the restoration of the piers of St. Paul's Cathedral in London; the treatment of sand and gravel deposits for the deep London subway tubes; and the treatment of dam sites prior to construction, together with the sealing of leakages from existing dams. At present the François cementation process is in use by the Italian government to prevent further subsidence in the Leaning Tower of Pisa by consolidation of the foundation gravel deposits.

The Dravo Contracting Company, with the company's English associates, entered into a contract with the Gulf States Steel Company for driving two tunnels, each 11 ft. in finished diameter, through the big fault and thereafter to continue with slopes down to the Big Seam beyond, no payment to be made to the contractors until the fault was successfully traversed. This last condition arose from the fact that the mine owners had had an unsatisfactory experience in their own effort and the attempts of other contractors whom they had engaged to cross the fault on a cost-plus basis. The lump sum proposition from the new contractors, who had confidence in their ability to accomplish the work, appealed much more strongly to them than any other plan.

Owing to the disturbance created by previous grouting operations, which would have necessitated the construction of an elaborate bulkhead dam in "A" Slope, it was decided to attack the fault at a new point intermediate between Slopes "A" and "B," and known as Slope "X."

The general plan for the work consisted in advancing the slope to a point about 50 ft. from the fault in a horizontal direction, and giving what was expected to be about 35 ft. of overhead protection. From this point a series of drill holes would be put out in a cone-shaped formation to intersect the fault plane on a diameter of 40 ft. Each drill hole, as soon as it tapped water, would be injected with cement grout up to a pressure of 2,500 lb.

per square inch, cleaned out, reinjected, and finally treated with chemicals until the water was completely sealed. This would create a treated and sealed grout zone around the proposed tunnel line sufficient to insure excavating without leakage. A pilot heading, 8x8 ft., would then be driven through the area into the limestone beyond, the tunnel enlarged, and finally permanently lined.

The normal provisions for lining were 24 in. of concrete, with a finished diameter of 11 ft. It was, however, expected that loose ground in the fault itself might cause difficulty, and once a cave started, the results might be serious.

Consequently, 35 lineal feet of cast-iron lining 1⅜ in. thick, and consisting of six segments and a key to the circle, were ordered and held in readiness against this eventuality, with the advantages that the groundwork need only be enlarged to 12 ft. diameter instead of 15 ft. in bad ground, and that only sufficient enlargement need be made to permit of erecting one segment at a time.

Drilling Required Powerful Machines

Owing to the hardness of the rock, it was not considered advisable to use the lighter and more speedy equipment which the contractors had used to drill percussive hammer drill holes to 150 ft. horizontally in the cementation operations connected with the Mersey Tunnel, at Liverpool. Accordingly, this job was equipped with two Model 34 turbo-rotation deep-hole drills supplied by the Denver Rock Drill Company. The special features about these machines are that they have a powerful rotating mechanism, which is independent of the hammer blow, and this can be used in withdrawing the steel from tight holes as well as boring through the rock. Furthermore, the machine, which weighs 225 lb., is extremely powerful, and is best mounted on a horizontal bar supported by two 4-in. machine columns. The drill rods consisted of 1¼-in. hollow Swedish drill steel, and threads are forged, in the drill sharpening machine, on the ends of each rod, so that they can be coupled together by an outside sleeve of high-grade cast steel.

A water swivel fits over the rods close to the machine chuck, and water is pumped into this swivel at 250 lb. per square inch, the stream passing through the drill rods and emerging at the bit. The bits used for long-distance drilling were 2⅜-in. diameter, six-point bits, and by not drilling too far with each bit, the gage can be maintained throughout the entire length of the hole, except in the very hardest ground, where some slight reduction becomes necessary.

All drilling was carried out through 2½-in. internal diameter extra-heavy mild-steel pipes inserted and securely grouted into the rock. To drill a hole large enough to permit this pipe to be inserted, four extra-large steel bits were forged, ranging from a 3¾-in. starter down to a 3⅜-in. finishing steel. Holes were drilled into the face to a depth of 12 ft. 6 in. with these steels, care being taken to pitch the holes at the correct angle. A 13-ft. length of pipe was then inserted into the hole and caulked into it with old hemp rope. The cement injection pump was then applied, and thus the grout was introduced at 400-lb. pressure. This cement was allowed to set for eight hours, when the pipe was cleaned out and bored 6 in. into solid ground. The pump was again applied and the holes tested to 2,000 lb. per square inch. Setting time of cement is greatly influenced by the pressure of injection, so that cement put in at 2,000 lb. is hard enough to clean out in the course of about two hours.

At Shannon Mines, two pumps were used—a 3-in. François with a maximum capacity of seven tons of cement per hour, and a 2-in. with a maximum capacity of three tons per hour. These pumps are of the double-ram type, driven by compressed air or steam and having a reduction of 20 to 1 from the motive cylinder to the ram; so that 125 lb. of compressed-air pressure will give 2,500 lb. per square inch on the rams. These rams, which are coupled together by crossheads and side rods, are of a special brand of iron, deeply chilled and accurately ground.

The pump valves are of cast steel fitted with removable seatings, upon which ground-steel balls operate. An important point in the design of a satisfactory pump for dealing with cement grout is that dead points must not exist in the pump, in which cement can settle if quiescent; otherwise the pump will soon become clogged.

To prepare the grout for the pump, the cement is mixed with water in the required proportions, in a tank elevated 4 ft. above the pump, whence it is run through a sieve into a similar tank on ground level. Agitators are revolved by bevel gearing driven by a small compressed-air engine, and these insure that the mixture is kept uniform. The suction pipe of the pump is taken from the lower tank and the grout delivered by the pump into a pipe line, whence it is passed through a specially heavy armored rubber hose into the standpipe of the borehole, which, in turn, is fitted with an extra heavy cast-steel plugcock.

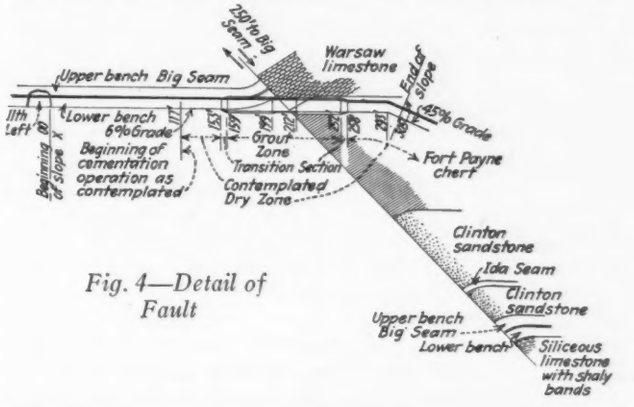


Fig. 4—Detail of Fault

The pressure of injection is indicated on a hydraulic pressure gage mounted on the injection pump. Indeed, the success of the operation depends on the expert skill of the operator in observing and controlling this pressure and varying the grout to suit the conditions of the strata which the gage reflects.

Chemicals are prepared from solutions of sodium silicate and aluminum sulphate to the required dilutions; in the Shannon mine, 7-deg. Bé. was used for the former and 4 deg. Bé. for the latter chemical. These solutions are pumped through separate pumps and allowed to meet at the entrance to the standpipe, where they react; the resultant colloidal precipitate is forced along the borehole into the fissures.

The effect of these chemicals under certain conditions is remarkable. I recall one instance in 1921 when a shaft encountered 1,000 gal. of water per minute in a 40-ft. bed of highly fissured and honeycombed limestone lying 720 ft. below the surface. Cement itself was utterly hopeless to seal the fine interstices, and it was not until more than twenty holes had been cemented without producing any material benefit that an elaborate chemical treatment program, involving precipitation in the rock fissures rather than in the standpipes, was undertaken. This was

completely successful, the colloid under pressure setting in the fissures and blocking the watercourses, so that the shaft was sunk without any pump at all and the slight residual feeders were ultimately sealed behind reinforced-concrete shaft lining.

Details of Shannon Mine Treatment

The information furnished by the mine owners from investigations on their part showed that the fault would be reached at a point about 165 ft. along Slope "X." Therefore, excavation was suspended at 117 ft., and preparations were made to carry out the proposed cementation treatment. Four boreholes were thereupon drilled at predetermined angles and standpipes were inserted and grouted into the rock in the manner already described. After withstanding their pressure test, the holes were drilled and the first change of ground was noted at 150 ft., when a gusher of water, gas, and black mud was struck in one of the holes. This, however, subsided to a steady stream of clear water; and the borehole was drilled to 205 ft. before it encountered real evidence of fault conditions. This hole encountered gravelly ground extending to 211 ft., which caused difficulty in drilling. The feeder, after the first rush of fault débris and highly sulphuretted water, steadied down to 10 g.p.m. —a condition better than had been expected from the evidence of Slope "A."

The conclusion therefore was reached that a change in the direction of the fault had caused a disturbance at 150 ft., but that the main fault lay at 205 ft. Four more boreholes were drilled through the changed ground at 150 ft., making eight in all; these were treated individually with cement injections to 2,000 lb. per square inch, to make them absolutely dry. Further excavation was then done on a heading 8x8 ft.; so that the pyritic material was safely passed without any water leakage, and a new program of cementation treatment was commenced from 157 ft. This time, eight boreholes were used as shown in Fig. 5, and disposed to cut the fault on a diameter of 40 ft., with two test holes drilled at the conclusion of the treatment. Cement was not readily accepted by the fault, but was ultimately forced in under final pressures for the various injections of 2,500 lb. Lastly, all holes were treated with chemicals to search out the fine fissures, and a further injection of cement was taken as a result of the lubricating action. Of the two test holes which were drilled, one was quite dry and the other showed only a trace of water, indicative of the success of the operation; so that it was considered safe to resume excavation on the 8x8-ft. section and pass through the fault to the limestone beyond.

Great care was taken with shot firing as the fault was approached and crossed, but the cementation was found to have sealed all water with the exception of one-eighth of a gallon per minute. The chief source of danger lay in caving ground. This was, however, not considered sufficiently serious to warrant the immediate introduction of cast-iron lining, and therefore the ground was temporarily supported on timber and a modification of the final scheme of lining was made by the owners, as shown in Fig. 2. The fault material was a mixture of shale, mud, and disintegrated pyrite, with intermixture of pebbles and breccia.

The heading at this stage had clearly passed the fault, the work proceeding through the transition section from the grout zone into the zone of expected dry excavation ahead. The owners had given assurance that once the fault was passed all water troubles were over and that once in the limestone the work would be in the dry. Because of their confident expectancy that no water would be encountered in the presumably solid cherty limestone beyond the fault, provision was made only casually for some exploration of the strata to the point where the slope was to change to a 45 per cent grade.

Pilot holes were accordingly carried forward in the limestone from the hanging wall of the fault at 212 ft. to the point where the grade of the slope changed, at 293 ft. No sign of water was found in these prospect holes, and the driving of the tunnel was advanced to 293 ft. with a change of section at 258 ft. passing from 8 ft. 6 in. x 9 ft., subsequently to be enlarged, for circular lining, to a standard cross-section of 14x9 ft., to be ultimately lined with concrete down to the Big Seam and giving a finished section 12 ft. wide by 8 ft. high at the center of the arch.

Water Unexpectedly Encountered

To facilitate haulage in the ultimate mining operations through the slope, the owner instructed the contractor to deviate from the abrupt change in grade at 293 ft. by commencing an easy vertical curve at a point a few feet ahead of the original knuckle to effect a transition from the 6 per cent to a 45 per cent slope. Arrangements for concrete lining not being quite completed, further advancement of the heading under this revised plan for the slope beyond 293 ft. was undertaken, but at 305 ft. the night shift of drillers suddenly tapped a flow of water in a drill hole 7 ft. beyond the face. At first the flow was small, and while arrangements were being made to deal with it, the entire electric lighting system of the mine unfortunately went out of commission for twenty minutes. The water meanwhile continued to increase in volume, and in two hours—by which time the cementation foreman was brought underground—the face was entirely flooded by a feeder estimated at 300 to 400 g.p.m. All the operations, including the driving of over 300 ft. of tunnel, had occupied from Feb. 22 to June 15, 1928, when this further water was unexpectedly struck.

Shannon mine was equipped with only one pump of 100 g.p.m. capacity, which normally dealt with 50 g.p.m. of mine water and leakage at Slope "A"; so that very little relief could be sought in that quarter, nor could extra pumps be had from stock to work against a 2,200-ft. head. The two ten-ton ore hoisting skips were resorted to, as they could deal with about 150 g.p.m. by installing a tank and sluice valve at the bottom of the slope for quick filling, which arrangement was put into force by June 17. Workings lying below the entrance to Slope "X" were available to store surplus water for an estimated period of sixteen days, after which the mine would be flooded beyond hope of recovery except by elaborate shaft pumping installations if this further water could not be sealed off.

For nine days the battle was fought with such air-driven pumps as could be immediately obtained, to get the face cleared of water, and—worse than that—of sulphur dioxide and hydrogen sulphide gas which was liberated from the water, particularly when it was broken into spray. The men suffered severely from sore eyes and throats, and few could continue working even with goggles supplied by the Bureau of Mines safety department. However, by Sunday night, June 24, ventilation had been improved, the water had been cleared by the pumps delivering to the mine workings, and more important than all, a second drill hole had been made with a $2\frac{1}{2}$-in. standpipe securely grouted in, which relieved the

pressure sufficiently in the first drill hole to permit a pipe being driven into it. Thus, all the water excepting 15 g.p.m. leakage was being piped away from the face and delivered directly to the lower mine workings without the help of pumps, though by this time it was estimated that the feeders amounted to 400 to 500 g.p.m.

An attempt at grouting the feeders directly would have invited disaster. A pressure gage on a diamond-drill hole in Slope "B," 700 ft. away, had dropped from 950 to 900 lb., showing that the water there was connected with that in the new flow, and therefore under the same pressure at both points. On such a limestone face, measuring 15 ft. wide by 9 ft. high, and with a fissure evidently extending over the whole area only 7 ft. away, 36 hours. By this time, the concrete had reached considerable strength, so that a plan of grouting could be undertaken. Six sacks of cement and sawdust were forced at 800 lb. pressure up the pipe leading to the original drill hole. The effect was immediate, and all leakage was sealed.

On Sunday, July 1, all the water was flowing out of the 2½-in. pipe inserted in the second drill hole. The 3-in. François cementation pump was coupled to this at a registered pressure of 810 lb., and grouting was begun with neat cement. In spite of some 9,000,000 gal. drawn off, the pressure dropped only from 950 to 810 lb., with no apparent diminution of flow. One can only hazard a guess as to the tremendous volume of water that would

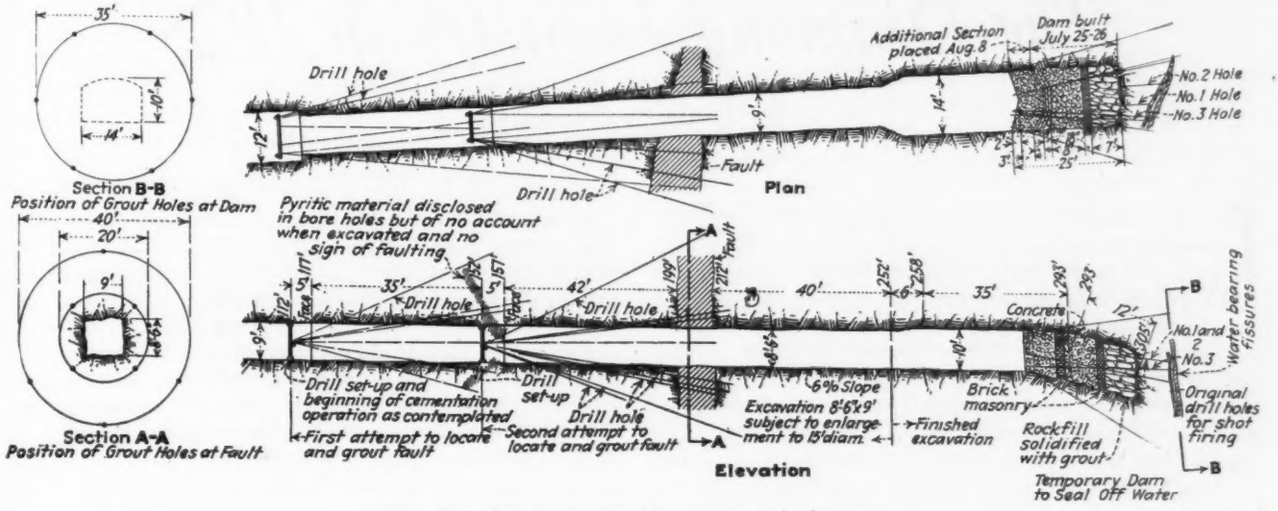

Section B-B
Position of Grout Holes at Dam
Section A-A
Position of Grout Holes at Fault
Drill hole
Additional Section placed Aug. 8
Dam built July 25-26
No. 2 Hole
No. 1 Hole
No. 3 Hole
Fault
Plan
Pyritic material disclosed in bore holes but of no account when excavated and no sign of faulting
Drill hole
Concrete
Water bearing fissures
No. 1 and 2
No. 3
Original drill holes for shot firing
Drill set-up and beginning of cementation operation as contemplated
First attempt to locate and grout fault
Drill set-up
Drill hole
Second attempt to locate and grout fault
6% Slope
Excavation 8'6"x9' subject to enlargement to 13' diam.
Finished excavation
Brick masonry
Rockfill solidified with grout
Temporary Dam to Seal Off Water
Elevation

Fig. 5 — Actual construction through fault zone

the enormous load of 68 tons per square foot, or a total of 9,180 tons, was liable to come on if the valves were closed. We therefore decided to build a dam on principles which had been previously employed successfully, although never against such an enormous pressure, and we were therefore exceedingly apprehensive about its effectiveness.

The construction of this dam was carried out in 60 hours, and completed on June 27. Reference to Fig. 5 shows the dam divided into two sections, ignoring the third portion added on Aug. 8 as a precaution against the possibility of defective valves. Seven feet from the face an 18-in. brick wall laid in sand-cement mortar was built; 8 ft. behind this a second wall with an arching effect served to contain concrete, the front section being filled with hand-placed rock. Eight cement injection pipes 2½ in. in diameter were laid in the dam as construction proceeded, two of these reaching the highest points of the rock fill to draw off all air.

To get any proper aggregate into the mine without stopping water hoisting was impossible, and as the shot limestone rock from the heading still remained underground in cars, it was used with cement and only a little sand brought down the main hoisting slope. Rapid-hardening cement was used, and as the temperature was 89 deg., this set very quickly.

On June 28, 130 bbl. of neat cement were injected into the rock fill to a pressure of 200 lb. per square inch, still leaving the water free egress through the two pipes inserted into the face. The same leakage of 15 g.p.m. around the pipe of the original drill hole made its appearance over the dam and defied efforts to seal it for have been liberated if this water-bearing fissure had lain two feet further ahead and the face had been blasted. The first injection of the fissure took 205 bbl. of cement without any increase of injection pressure above 840 lb., so at this stage the valve was closed to allow the cement to set.

A herculean task had been accomplished—the dam held tight and the mine was saved. It was, however, only the first task, and a more uncertain problem was still to be handled and solved. The fissure, fault, or whatever it might be, had to be sealed before the tunnel could be advanced to the ore. Between July 2 and 14, not fewer than 851½ bbl. of cement, together with some limestone dust, were pumped into the fissure before definite signs of filling were seen. In the meantime, No. 3 hole had been drilled through the dam into the fissure. This hole first struck a flow of 50 g.p.m. One foot beyond there was literally an explosion which caused several men to run for their lives. Amid a terrific roar of water, the steels had become stuck in the 2¼-in. drill hole, and when the foreman struck these with a hammer they flew out of the hole in a streak of fire and shattered as they struck the rock sides of the drift thirty feet back. The valve had not, however, been damaged, and with 600 g.p.m. rushing out the foreman closed the water off. When one considers a city fire brigade's jet of perhaps 1 in. diameter, and multiplies the volume and speed of the jet by about six, one begins to appreciate the conditions in the Shannon mine workings at this time.

A temporary suspension of work occurred between July 14 and 22, when a program consisting of drilling

six holes on a cone round the dam was undertaken to intercept the fissure at points far enough away from the line of the drift to permit safe excavation of the tunnel. All these holes cut the fissure, but with little or no water; so that the further injection of 176 bbl. of cement had to be put in at increased pressure, which served to tighten up this further water zone.

The question of exploring the entire strata by a diamond-drill hole and further extension of the tunnel is deferred, owing to differences between the contractor and the owner as to whether the latter should make payment for the work already done, and for any possible extension of cementation operations in the event of encountering further unexpected water.

The Gulf States Steel Company was represented in this work by L. E. Geohegan, vice-president and general manager, and The Dravo Contracting Company executed the work under the direction of E. T. Gott, vice-president, to whom I acted as technical advisor.

It is believed that never in the history of mining has water been encountered in such volume and under such pressure, and it is certain that no organization has ever previously succeeded in stopping an underground flow under such conditions.

The Diamond Industry in 1928

By Sydney H. Ball

Mining Geologist, New York City

IN A COMPREHENSIVE REVIEW of the diamond industry we cannot overlook the fact that 1927 and 1928 were years of some anxiety, a result, in 1927, of the large production of inferior stones from the Lichtenburg district, Transvaal, and in 1928 of the large production of fine stones from the Namaqualand field, Cape Colony. Both of the fields are alluvial, and, like most South African fields of this character, their flush production was of short duration. The Lichtenburg production in the last quarter of 1928 was no longer alarmingly large, and the cream of the Namaqualand production has already been skimmed. The first district produced poor material, difficult to market; in contrast, the second produced magnificent rough capable of being cut in the larger stones of quality, of which there is now a shortage. Both districts will produce for years to come, but their flush production is a thing of the past.

The large production of the past two years has been offset by an unexpectedly large demand. At the year end, the industry faced the future confidently with stocks normal, with an average upward price trend, with sales on a satisfactory scale, and with reasonable expectation of a diminished mine production in 1929.

Noteworthy is the fact that the loci of the production of few other important mineral products are so nearly confined to a single continent, as is the condition with respect to the diamond production to Africa. In 1928, South America, with the slight aid of Borneo, Australia, and India, accounted for 2.6 per cent, and Africa for 94.4 per cent. South African pipes furnished 31.8 per cent and its alluvials 27.1 per cent, a total of 58.9 per cent; the Belgian Congo and its extension into Angola produced 23 per cent; and the Gold Coast, South West Africa, and Tanganyika Territory, respectively, 8.4 per cent, 7 per cent, and 0.3 per cent.

Sales Greater Than in Any Previous Year

The diamond market in 1928 was remarkably strong, and sales were apparently greater than in any previous year. Former estimates of the world's demand for rough —namely, $65,000,000 to $75,000,000 annually—must be adjusted upward to approximately the $100,000,000 mark. By mid-summer the Diamond Syndicate, in addition to selling current production, except that part of the Namaqualand production withheld from market by the South African government, had disposed of its stock, said to amount to about $40,000,000, largely Lichtenburg stones. The Syndicate's position, which a year ago was trying, because of the huge sum tied up in diamonds, is now easy. During the year, confidence, if it were ever shaken, has been re-established, stocks became normal, and the average price of rough increased. The existence of sample stocks in London, and the now established principle of hand-to-mouth buying, have resulted in neither the brokers nor retailers carrying large stocks. This, together with the strong demand at the year end and general world prosperity, indicates that 1929 will be an excellent year.

Favorable Factors

General world prosperity accounted for the phenomenal sales of 1928. The retailers in the United States did not increase their sales over 1927 till the last quarter of the year, when a large holiday trade lifted the year's sales above those of the preceding year. Smuggling of cut stones into the country on a large scale, possible changes in the tariff, and the Presidential election kept some American buyers away from the European markets. The American tourist made large purchases, and, strangely enough, appears satisfied to purchase in Europe a stone inferior to that which he demands of his own jeweler.

With its extraordinary prosperity and its increasing appreciation of diamonds, the United States, which normally takes from 75 to 80 per cent of the world's cut stones, guarantees the 1929 market. Canada increased consumption by about 10 per cent in 1928. Since the war, the industry has regained practically all of its market except Russia, although England and France still do not take their pre-war quotas. The Central Powers, Poland, the Baltic republics, and the Balkan States are again purchasers. Italians are demanding better stones than in pre-war times, which to a less degree is a definite tendency elsewhere. Japanese and Chinese demand has been affected by political conditions, but Siam is purchasing relatively large quantities of small stones of fair water, particularly from Belgium.

The Diamond Syndicate continues to handle over 90 per cent of the world's rough diamonds and is an invaluable balance wheel to the industry. During 1928, it made

arrangements to handle such of the Namaqualand stones as the South African government sees fit to sell. Some of these stones are now on the market. It continues its rational and wise marketing methods, and, with the fine Namaqualand rough at hand, it can as needed furnish rough for the large fine gems now so popular. There is a considerable stock, perhaps in the neighborhood of $31,000,000, of this fine material in Cape Town.

In the last few years cut stones to a value variously estimated at from $40,000,000 to $50,000,000 are yearly smuggled into the United States, the incentive being the high duty (20 per cent) thus saved on an article of great value which can be readily hidden and introduced at any point in our extensive border. The amount is sufficient to jeopardize honest diamond merchandising in America. As is always the case, it is stones of the finer qualities which enter the country illegally. The country, however, is not the only scene of smuggling; Canada has a similar fight on its hands; a smuggling ring has been apprehended in Poland; and diamonds are being smuggled into the Baltic republics.

Developments at South African Pipe Mines

De Beers Consolidated Mines is not only the premier diamond mining company of the world, but also a veritable diamond investment trust, controlling Premier and Koffyfontein and having large holdings in Jagersfontein. The Premier Diamond Mining Company, being a producer of mediocre diamonds, reduced its production markedly in 1928. It has started to sink an inclined haulage tunnel in the country rock outside the pipe which when completed will prolong open-cut mining many years. The position of the New Jagersfontein Mining & Exploration Company should be further improved when the up-to-date direct treatment plant started in November, 1928, is completed.

In addition to these leaders there are eight or nine minor pipe mines. Koffyfontein Mines is the most important of these. Crown Diamonds Company, in the year ended June 30, completed its change-over from an open-cut to an underground mine. The deepest workings are at 955 ft., but most of the ground treated came from above the 570-ft. level. Phoenix Diamonds has a small but efficient mill, and the mine is being developed down to the 135-ft. level. New Eland & Frank Smith (1926) Diamond Mining Company was also a small producer, and Oslo Diamonds reported diamondiferous yellow ground discoveries in the Wenburg district, Orange Free State.

Operations at the Alluvial Fields

The New Vaal River Diamond & Exploration Company produced in 1928 a little less than 10,000 carats of fine stones. The African & European Investment Company and several other land companies were forced to cease mining by the Precious Stones Act, as was Treasure Trove Diamonds.

The diggers' lot has never been a happy one, and, although a few are lucky, the great majority have nothing to show for their work, and many are poverty stricken. One digger estimates that 75 per cent are continually on the brink of starvation; 20 per cent make a sufficient living; and 5 per cent do very well. The sensation of the year was the opening up of the Namaqualand deposits, but it was by no means as sensational as the yellow journals would have the layman believe. Production was not so remarkable for volume as it was for grade. The field produces fine large stones, of which there has been an actual shortage in the market for several years.

In the Central African diamond field numerous alluvial mines in the Kasai River drainage on either side of the frontier of the Belgian Congo and Angola made a normal increase in production. Consolidated Diamond Mines of South West Africa announced in November that to the north of the Orange River it had found an extension of the Namaqualand field.

Decline in Carbonado Prices Predicted

The market for industrial diamonds was good during 1928. Large carbonado and bort were scarce, and the demand for the better grades was excellent. Carbonado prices were higher; crushing bort remained at about $2 per carat. Production of carbonado in Brazil appears to be increasing, the 1928 production being about 25,000 carats.

The Bahia Corporation is installing a new washing plant, and the 1929 production will presumably exceed that of 1928. This, together with the placing on the market of several excessively hard alloys suitable for diamond drilling in soft sedimentary rocks, suggests a fall in carbonado prices during 1929.

Crucibles Developed to Resist Molten Sulphides at 1,500 Deg. C.

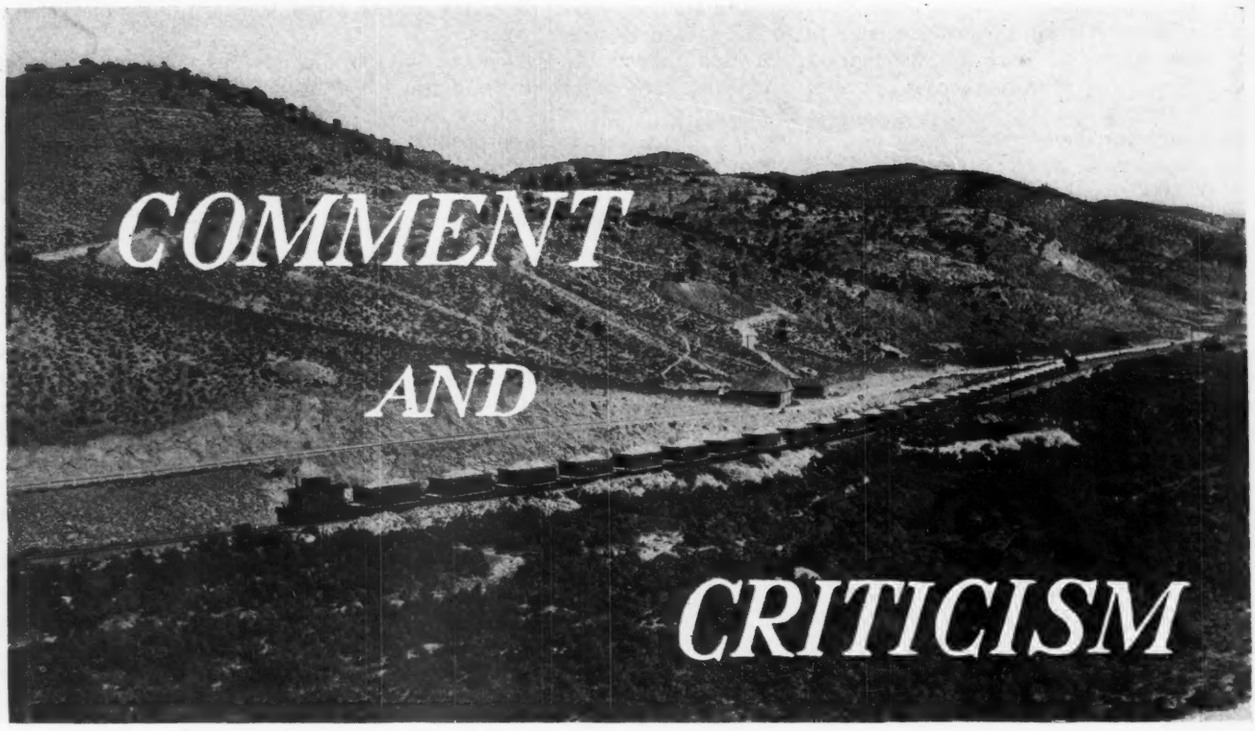
CRUCIBLES which will withstand attacks of molten sulphides at high temperatures have been developed by the U. S. Bureau of Mines as the result of work done at the Southwest Experiment Station of the Bureau at Tucson, Ariz.

In the course of a comprehensive investigation of the reduction of magnetite by molten sulphides, undertaken in co-operation with the University of Arizona, it became necessary to devise a method of making crucibles of a suitable material which would hold such melts, and the following technique was finally evolved:

Pure electrically fused magnesium oxide, mixed with 3 per cent alumina, was ground to pass 350 mesh. A suitable quantity of the mixed oxides was moistened with 7 per cent, by weight, of 25 per cent magnesium chloride solution, and tamped firmly into a three-piece mold lined with heavy paper to form a slug having the shape of the outside of the crucible desired. Then the mold was placed in the chuck of a lathe and the slug was hollowed out to form a crucible, which, after drying, was fired in a high-frequency induction furnace at a temperature increasing over a period of two hours from that of the room up to 2,100 deg. C.

Crucibles so prepared are very dense and will hold a molten mixture of iron sulphides and oxides for 45 min. at a temperature of 1,500 deg. C. without appreciable seepage. The melt will take up in that time about 2.5 per cent magnesium oxide. This may be considered very satisfactory when one takes into account the temperature, the corrosive nature of the melt, and the relatively large surface presented to the melt by very small crucibles.

Among other refractory materials whose properties were investigated were thoria, zirconia, chromite, and alumina. The three former were readily attacked by sulphides at high temperatures, and alumina did not resist the action of molten iron oxides well. Silica and siliceous refractories were, of course, useless because of the basic character of the melt.



Subjects Within and Without the Domain of Government Bureau Investigation

Need Stressed for More Knowledge of Physical Characteristics of Ores and Less Opinion of Competitive Geophysical Methods

To the Editor of "E.&M.J.":

I read Mr. Wooton's reports of the hearing before the Mines Committee of the Senate published in your issues of March 2 and 9 and have since received a copy of the full report. I find that Mr. Wooton's report did not cover fully the discussion regarding geophysical prospecting, but, in commenting on that portion reported by Mr. Wooton, perhaps I may be permitted to make some comments on that portion which was not reported.

No one reveres research work more than I do, and I do not even object to its being done by a government agency if the subject is one which is of public benefit. And it would be of public benefit to have certain fundamental factors which enter into geophysical prospecting investigated. As far as the underlying physical factors are concerned, a great deal of work has been done by private investigators, and, for the most part at any rate, published. Indeed, a great proportion of the principles involved have been the basis of application for patent, and, besides this, have been described under one cover in "Elements of Geophysics," by Dr. Richard Ambronn, and individual methods have been described at great length in the technical press and publications of the technical societies. Certainly, the first step in starting research on a subject is to collect all available information, in order to avoid repeating what has already been done. It seems to me, therefore, that Mr. Turner gives a wrong impression when he says " . . . no general survey of fundamentals has been made."

Perhaps I do not understand him, however, because he continues by saying: "We would like to begin studies in the determination of resistivity to electrical and seismic waves of various mineral formations." Here is a subject which, I think everybody will agree, can be usefully investigated; any information obtained regarding physical characteristics of rocks in the different sections of the United States will be put to the same sort of use as the U. S. Geological Survey bulletins and folios. Such an investigation properly falls within the domain of a government agency, whether Bureau of Mines or U. S. Geological Survey.

It is, however, the discussion of the practice of geophysical methods reported at the hearing and the pamphlets which the Bureau of Mines has issued on which I particularly desire to comment. Let it be said at the outset that a geophysical survey is somewhat similar to a geological survey. Both, properly performed, entail a careful "going over" of the area examined, and the result of either is dependent on the professional ability of the operator. There is no mystery about the making of a geological survey, although very few people know how to make one. Exactly the same thing may be said of a geophysical survey, but the number of people who know how to make one and interpret the results is even fewer. The main difference between the two operations lies in the fact that the methods and instruments used by the geologist are free for use by anyone, whereas most of the methods and apparatus used by the geophysicist are patented—hence not free for use to anyone. But even if they were, as the publications of the Bureau seem to imply, they would be of no use to anyone unless he had a long training in the methods and in the interpretation of the results obtained.

The small operator or the prospector, in whom the committee manifested such interest, can just as well have a geophysical survey made as he can have a geological survey made. In either case he should employ a man competent in his line. To think, however, that the small operator or the prospector can perform his own geophysical survey is just as reasonable as to think he could make his own geological survey; the result in either case would probably be of no value.

Apparently, the Bureau of Mines is trying to determine which of the electrical methods is the best. As is apparent from the reading of the many publications on the subject, there is a wide variety of methods. Almost all have some merit in experienced hands, and no single method is capable of universal application; some are best under one set of conditions, others under other conditions. The plan of the Bureau has been to try various methods on one deposit. In skilled hands, and with skilled interpretation, some methods on one deposit would show better results than others, but that does not mean that, on another deposit, those failing the

first time might not prove to be best. The tests of any method can be conclusive only if conducted by operators skilled in the use of that method and in the interpretation of the results. Certainly, the Bureau's publications do not indicate any such skill, and, although hope is held out to the average mine operator that, through these publications, he will be able to do his own prospecting, those trained in the practice can see only failure in such attempts, with consequent discredit to electrical prospecting in general.

The statement that no results are made public "except through some federal agency," and that the federal government is the only agency that can be looked to, to give information to the general public, surely overlooks the voluminous publications of the A.I.M.E. and the technical press. A considerable number of descriptions of actual surveys and results obtained in the United States as well as in other countries have been published from time to time for the last four or five years. The Schlumberger company, as well as our own, has been very free with descriptions of this kind, and I have no doubt would publish more were the company not, as we so often are, restrained by the reluctance on the part of clients to make the results public. As to the results by the seismic and gravitational methods, much has been published regarding these also, although there are undoubtedly many cases of success where the results are kept quiet. But already enough examples of the success of geophysical prospecting have been published to show that nothing will be gained by giving the Bureau money for further publication.

We take exception to most of the work of the Bureau so far, because—

First: The hope is expressed that there is an instrument or a method which anyone can use to find concealed ore on his property. It may be thought that our objection is based on fear of competition and consequent loss of business, and, in a sense, it is; not because of the expectation that any such hope will be realized, but because such an expectation, unrealizable as we believe, tends to discredit the art of geophysical prospecting. For it is not a science but an art, the successful practice of which is based as much on the judgment resulting from long experience as it is on the knowledge of the underlying sciences of geology and physics.

Second: The attempt to decide which is the best method. Of the many methods available, particularly for ore prospecting where the electrical methods are most applicable, no one method can be said to be universally preferable. Furthermore, most of the methods tested are patented and hence not public property, so it would appear entirely outside the province of a government agency to make any statement regarding the relative merits of such patented methods.

Third: The tests are made by men unskilled in the use of the methods. It is apparently assumed that such simple conditions as are met in a laboratory set-up are duplicated in the field. It may be said that they are never so simple; the simplest conditions met have complications which can be taken into account only by experienced geophysicists. The conclusions of unskilled operators are quite certain to be incorrect, not alone regarding the results obtained by one method but also regarding the relative merit of the methods.

To offset this destructive criticism, let me make the suggestion that the Bureau of Mines or the U. S. Geological Survey be charged with the duty of investigating the physical characteristics of formations, rocks, and ores, and leave the small operator and prospector to find out for themselves who is the best geophysicist, just as they would now have to find out who is the best geologist or mining engineer. The geophysical survey of a camp or a district would be greatly facilitated if we knew the physical characteristics of the local rocks, as, for example, their specific gravity, porosity, saline content of the contained moisture, electrical conductivity, magnetic permeability, and rigidity or elasticity. Geologists of the Survey could advantageously add to the sum of data they collect, tests of the conductivity of the waters of a region. Often such tests made in the field reveal such great differences as to imply entirely different origins. Furthermore, as the conductivity of almost all, if not all, silicate or carbonate rocks is due entirely to the conductivity of the moisture they contain, such tests would contribute to a knowledge of the electrical conductivity of the rocks of the region. In fact, a procedure for the determination of this conductivity (not determinable by laboratory measurement on hand specimens) has been worked out by the determination of the porosity of the rocks and the saline content of the moisture.

ALLEN H. ROGERS,
President, Swedish American Prospecting Corporation.

New York City.

Dr. Banks Corrects an Error

To the Editor of "E.&M.J.":

The following statement appears in the news column of your issue of April 6, on page 572:

"Dr. Banks testified that there were 30,000,000 tons of copper ore blocked out at the Batamote mine and that he believed that it could be worked at a profit of $1,750,000 a year, if the grade of 1½ per cent copper could be maintained."

No such testimony was given. In a report made on the Batamote property in June, 1927, I estimated the ore averaging 1.58 per cent copper exposed on the 600-ft. level at that time as about 1,300 tons per vertical foot.

I was subpoenaed to testify in the recent trial of the Canario people. My report was in evidence. To a question whether 1½ per cent ore could be made to pay at Batamote, I replied that it could, provided the tonnage was sufficient. To a further question as to what tonnage would be necessary, I replied that in my opinion it would have to be sufficient to assure the operation of a 4,000-ton mill for about twenty years, and, to a further question, that this would mean a total of about 30,000,000 tons. Nothing was said of "a profit of $1,750,000 a year.

JOHN H. BANKS.

New York City.

Mr. Foss Attacks the Manganese Tariff and Recommends a "Stockpile"

To the Editor of "E.&M.J.":

High tariff on manganese ore—1c. per pound of manganese content, or about 60 per cent ad valorem—has existed now for six years, during which domestic manganese ore mining has contributed to the industry very small tonnage. Fifteen thousand tons of metallic manganese, averaging about 5 per cent of the United States consumption, is all that was delivered last year by domestic producers.

As far as the ferro-alloys industry is concerned, it is safe to say that manganese ore mining in the United States does not exist, and according to very authoritative and eminent mining men and geologists, it *never will exist.*

What passes under the name of manganese ore industry in the United States actually is the mining of low-grade ferruginous manganese ores, which lend themselves to beneficiation with the greatest difficulty. This industry exists only because of the high tariff on the imported high-grade manganese ore, and the day this duty is abolished, mining of lean manganiferous ores in the United States will stop.

It is evident that economically the duty on manganese ore is nonsense. The only pro-tariff argument on manganese ore that should be considered is that of war-time emergency. To be able to make deliveries of manganese ores from deposits of lean hardly workable ferruginous manganese ore in time of war, it was decided to support "a knowingly lost cause," at a cost to the nation of about four and one-half million dollars every year.

Whether in case of war the domestic manganese ore industry will be able to supply the necessary quantities of high-quality manganese ore is very doubtful, and no one at present can give assurance of it. Such assurance, however, lies in another measure which is prompted by common sense and simple arithmetic.

As it was recommended by the committee of the American Institute of Mining and Metallurgical Engineers in 1923 and later on seconded by the Secretary of War, the best way to provide for a war emergency is to purchase 600,000 tons of high-grade manganese

ore and keep it in stock. This stock, with the regular inventories at steel plants, may tide us over for more than two and one-half years.

Putting it in other words, the committee of mining engineers has suggested creation within our borders of a "manganese ore mine" which will last for two years in case of emergency. Creation of such a mine, which will give an unequivocal and not probable service, will cost about eleven million dollars. Yearly interest on such investment amounts to six hundred thousand dollars. As six hundred thousand dollars is less than four million and five hundred thousand, which is spent for duty on manganese ore and ferromanganese each year, it is clear that the suggestion of the mining institute's committee is more profitable to the country.

Besides, in such case, domestic deposits of ferruginous manganese ores will be with us in case of emergency and not partially depleted, as they are going to be if unprofitable domestic mining be supported at the expense of the nation.

The only question that arises is, who is going to finance the creation of this "manganese mine" within our borders? Being connected with defense of the country, such measure should be financed by the government. But as the industry wishes the government to "keep out of business," would it not be to the advantage of ferromanganese users if this financing were left to the producers of ferromanganese, with the understanding that the expense of carrying excessive stocks will be borne by the commodity? In this way this extra expense will be justly prorated and the ultimate consumer of iron products will be far better off than now.

FEODORE F. FOSS,
Wheeling Steel Corporation.
Wheeling, W. Va.

BY THE WAY

United States Capital Financing Canadian Mines

MUCH CAPITAL has gone across the northern border of the United States in the last few years to aid in the development of Canadian mines, though Canadians themselves have not been backward in supporting their own enterprises. The part that the United States has played and is playing is the subject of an interesting advertisement by the Seaboard National Bank that recently appeared in the New York *Herald Tribune* under the title "Thar's gold in them hills." Just who is responsible for this saying we do not recall, but it is our impression that it should be "them thar hills." However, that is beside the point. The advertisement reads in part as follows:

"In the northern part of the Canadian province of Manitoba, hundreds of miles from Winnipeg, lies a vast tangle of wilderness known as the Flin Flon.

"To Canadians the Flin Flon has always been a queer enigma. Though experts believed there was gold and copper there, nothing save the call of the bull moose and the howl of the timber wolf had broken its wooded silences these hundred thousand years.

"For, in order to develop the mining possibilities of the Flin Flon on a colossal scale—as they should be developed—it was essential that the job should be undertaken by a powerful financial group.

"American interests saw this opportunity, and now a railroad has been built to bring the Flin Flon nearer to the industrial zone. Plans also include a huge power plant in the territory for the operation of smelters.

"The Flin Flon development in Canada is typical of what American capital is doing in many foreign countries today by co-operating with their leading financial interests. American dollars are being invested in foreign industries—and where America's invested dollar goes, the way is cleared for American trade to follow.

Last year, Canada—for the first time in our commercial history—displaced the United Kingdom as the largest foreign buyer of American goods. Canadians are enjoying a sound and growing prosperity and many an American business man is digging gold in Canada today, though he does it with goods rather than with pick-axes or steam shovels."

Without doubt, the presence of United States engineers and money in Canada is responsible for a large part of the stimulus in trade to that country, and manufacturers of mining and other equipment should not overlook their opportunities.

Another Ventilation Problem Solved—by a Columnist

LAST JANUARY, when the new Cascade Tunnel, on the main line of the Great Northern Railway, was dedicated and opened, it was pointed out that completion of the $14,000,000 project marked a great step forward in bringing the West Coast closer to the East. But, inspired by the recent cold weather in Seattle, Wash., the columnist of the *Post Intelligencer*, of that city, contends in the following prose-poem that both advantages and disadvantages may accrue from the more intimate East-West relationship provided by the new tunnel:

"Listen, my children, and you shall hear what makes our weather at present so queer. Just three weeks ago, or maybe 'twas four, they opened to traffic the Great Northern bore. The very next day, as perhaps you recall, the doggone thermometer started to fall!

"The wind from the East, it started to blow, and first we had frost and next we had snow. It snowed and it froze and the mornings were raw. We're waiting and hoping, but still there's no thaw. There must be a reason behind it, no doubt, and so, while I shivered, I figured it out.

"That hole through the mountains is causing a draft, like breezes that sweep through a dumb-waiter shaft. The winds from Montana they sweep through the bore, and so we are frozen as never before. Our coal piles are shrinking, our faucets won't run; and all are complaining, yet nothing is done!

"Of course the new tunnel, it fills a great need. It cuts down the mileage, increases the speed. But may we suggest as a well-meaning friend they hang up a storm-door, at least on this end? And may we suggest to the railroading crew, they close it behind them when they have passed through.

"And early next summer, when heavens are fair, we'll ask that the storm-door be taken from there. And thus in the Inland, where folks often roast, they'll all be refreshed by a breeze from the Coast."

Hoover Politics Baffles So-called Party Leaders

"ONE of the most interesting things in Washington these days," according to a recent issue of *The New Republic*, "is the tense effort of the so-called party leaders and so-called political publicists to understand the so-called Hoover politics. Ultimately this may become clear to them, but the net and not very satisfactory result to date is an epidemic of headaches and dizzy spells among both classes, with practically no illumination of the subject at all. For the most part stiff-minded, tightly wedded to preconceived ideas, and sticklers for precedent, they are unable to comprehend the Hoover type of President, because it is so completely different. Most of them have been going on the assumption that the President, being almost wholly without political experience, and concededly having no liking for politics as a pastime, stands in need of and must have a political wet nurse in order to keep out of trouble with the politicians, now that he has managed to get into the White House.

"It is enormously disconcerting for them to find he neither needs nor uses any such thing, that actually he has as clear a grasp of practical political facts as any politician, that he is not only thoroughly informed as to who's who and why in the party organization, but, as he is equipped with better mental sight, sees farther and deeper into a practical political situation than any of his aides. In other words, it is exceedingly disturbing to the old-time party leaders to discover that Hoover, the amateur, has put his mind on the politicians' particular specialty and knows more about it than they do. It will take some time for this simple fact to seep in, but it is true. The political aides of Mr. Hoover, such as Mr. Good and Mr. Brown, are to be used not to determine political policies but to carry out the details after they have been determined. They are to be used as buffers and 'contact' men, but not as problem solvers. The problem solver is in the White House."

Personal Notes

James B. Moulton, of the banking firm of Hornblower & Weeks, has been elected a director of Quincy Mining.

Foster S. Naething, consulting mining engineer, has moved his offices from St. Louis to 74 Trinity Place, New York City.

James E. Grant has resigned as manager of Wright-Hargreaves Gold, operating in the Kirkland Lake district of northern Ontario.

W. R. Wade, mining engineer with the John Hays Hammond interests, has gone to Idaho for a month's work in mine examination.

Army Adams sailed for Alaska on April 16 with a crew of 25 men, to conduct hydraulic operations at Haines, Alaska, near Skagway.

James Hutchinson has been elected president of Quilp Gold Mining, which operates properties in the Republic district of Washington.

Allen H. Rogers, of the firm of Rogers, Mayer & Ball, has sailed for Europe from New York. He expects to be absent about six weeks.

E. P. Crawford is now with Ventures, Ltd., the holding company of the Lindsley interests. His headquarters are at The Pas, Manitoba, Canada.

Lucien Eaton, superintendent of mines in the Michigan iron ore district for Cleveland-Cliffs Iron, was recently in Washington, D. C., on business.

D. C. Jackling will sail for Europe about May 1, where he will spend several months on vacation in France, Germany, Scandinavia, and England.

Thomas Donnelly, consulting mining engineer, of New York City, is leaving for the Kildoon mine, at Matehuala, San Luis Potosi, Mexico, within the next week.

Erskine Ramsay, of the Alabama By-Products Company, of Birmingham, has been elected chairman of the southern division of the American Mining Congress.

Leslie E. Ellis, assistant city engineer of Santa Cruz, Calif., has resigned and will become associated with the Hercules Mining Company, of Wallace, Idaho.

W. B. Airth has been appointed consulting engineer and manager of field operations of the Duparquet Mining Company, Ltd., in the Rouyn district, Quebec.

Hans Lundberg, of the Swedish American Prospecting Corporation, has returned to New York after three months' absence in Sweden and other parts of Europe.

John W. Mercer, general manager of the South American Development Company, operating in Ecuador, South America, announces the removal of his office to 225 Broadway, New York City.

Clarence Thom, metallurgist, who has been associated with the U. S. Bureau of Mines station at Moscow, Idaho, for

CLARENCE THOM

the last year or two, has been appointed metallurgist for Glacier Silver-Lead Mining, at Libby, Mont.

Paul A. Gow, of Butte, was re-elected president and general manager of North Butte Mining, operating in the Butte district of Montana, at the annual meeting of the company which was recently held.

E. W. Todd has been appointed consulting engineer for Trout Creek Gold Mines, in the Kirkland Lake district, northern Ontario. **A. McKenzie** has been appointed resident manager of the company.

J. J. Bourquin, of the Salt Lake City office of the U. S. Geological Survey, has been transferred to Denver, where he will assist **Cuthbert C. Mather,** acting head of the mineral leasing division of the survey.

Benjamin F. Hill, mine operator in the Cripple Creek district, and **William A. Way,** of San Juan County, have been appointed members of the board of trustees of the Colorado School of Mines by Governor W. Adams.

Louis V. Bender, manager of the Washoe plant of the Anaconda Copper Mining Company, has been appointed to the executive board of the Montana State School of Mines by Governor Erickson of Montana.

Edward B. Durham, mining engineer, left the employ of the Nevada Consolidated Copper Company, at Hurley N. M., on April 1, and now is engaged as designing engineer for Comstock & Wescott, Inc., industrial engineers, Niagara Falls, N. Y.

J. D. Sears left on April 16 for field work in the southwestern part of the San Juan Basin, N. M., for the U. S. Geological Survey. He will be assisted by **T. A. Hendricks,** of the University of Colorado, and **W. S. Pike, Jr.,** of Johns Hopkins University.

Charles M. Schneider, mining engineer, of Denver, sailed on April 20 on the "Adriatic" for London, where he will assist **A. G. McGregor** in the design of the Roan Antelope concentrator. Mrs. Schneider and Charles M., Jr., accompanied Mr. Schneider.

C. Minot Weld, of Weld & Liddell, mining engineers, of New York City, will attend the annual meeting of the U. S. Chamber of Commerce, at Washington, D. C., April 29-May 3. Mr. Weld will attend as a member of the advisory committee of the Natural Resources Production Department of the chamber.

Michael Sotock, metallurgical engineer, recently with the Deister Concentrator Company, of Fort Wayne, Ind., sailed from New York for Colombia, South America, on April 20, on the Grace liner "Santa Inez." Mr. Sotock will supervise some experiments on the utilization of pneumatic concentrating equipment on the coffee plantations of W. R. Grace & Company.

Lester J. Hartzell, Carol P. Donohue, Theodore Bullock, Calvin Pearce, Walter F. Meckel, S. W. Stockdale, and **W. L. Kern,** of the technical staff of the Anaconda Copper Mining Company, in Montana, have been transferred to the Chile Copper Company, Anaconda's affiliated operation at Chuquicamata, Chile. They will leave Butte for South America within the near future.

George C. Klug, of the firm of Bewick, Moreing & Company, is in New York on his way from England to Australia. In company with **John Adam,** assistant superintendent for the Zinc Corporation, and **W. D. Whiteman,** manager of the British section, of North Broken Hill, Broken Hill, Australia, he is leaving for the various mining districts in the West, where they will study American methods of mining and metallurgy.

OBITUARY

B. F. Baker, president of the Arizona Cinnabar Company, died on April 14 from injuries received in an automobile accident which occurred 7 miles north of the Roosevelt reservoir, in Arizona, while he was on his way to the company's property in northern Gila County.

Frank Carbis, who was engaged in mining on the Menominee iron ore range for many years, died at his home in Iron Mountain, Mich., on April 5. He was 71 years old. When the Traders mine, of which he was superintendent, closed six years ago, Mr. Carbis retired from mining.

Digest of Current Literature

Passivity. Agnes M. Hasebrink. *Zeitschrift für Elektrochemie,* December, pp. 819-29. In a study of the passivity of metals and its causes, some significant observations have been made in connection with the electrolytic treatment of chromium and nickel. Hittorf had reported in 1900 that iodine had a passivating effect on chromium. Repetition of his experiments did show a passivation in the range from 2 to 6 volts; but at 8 volts iodine readily activates passive chromium. The same is true of nickel also, but since nickel does not become passive so readily as chromium it is easier to activate, and the effect of the iodine or other activating agent is relatively greater. Tables of data are given, showing the results of the passivity and activation experiments.

Powdered Fuel. G. E. K. Blythe, *Metal Industry* (London), Feb. 15, pp. 177-9; March 1, pp. 231-2. Use of powdered coal for various metallurgical furnace processes has improved the cost efficiency of these operations. Ordinary coal burning is so inefficient that other fuels, especially producer gas, have been much favored for metallurgical heating. Operating data of many months can now be cited, however, to show improved results with powdered coal, not only in melting iron but also in the operations of copper refining and in reverberatory furnaces for nickel. The heat enters the metal more uniformly than from gas or oil, and better flame control gives a better quality of product. An application to copper refining is described.

Feldspar. B. M. Schaub, *Economic Geology,* January-February; pp. 68-89. Mr. Schaub describes what he considers to be a unique feldspar deposit. It is located near De Kalb Junction, N. Y. The ordinary type of deposit, occurring in pegmatite as does the one considered, is usually either of an acid or a basic type. However, the deposit described is neither, being characterized by having the principal constituents corresponding to those of the acid type, whereas the accessory constituents are of the basic type, in this case diopside, tremolite, phlogopite, and titanite. Tourmaline, beryl, and even garnet, so common in acid pegmatites, are rare or absent. The wall rock is limestone, in contrast to gneiss or schist of most other American localities worked for feldspar. The body is of roughly tabular outline.

Smelting Scrap. *Metal Industry* (London), Feb. 22, 1929; pp. 207-8. Recent improvements in equipment for preparing scrap, swarf, borings, and the like for remelting and refining include a double-acting hydraulic scrap bundling press and a hydraulic press for swarf and borings. In view of the greater pressure required to compact swarf and borings, the latter machine is of particular interest. The pressure exerted by this press (about 4,200 lb. per square inch) is sufficient so that the briquettes cohere of themselves and no binder is needed. The loose material is reduced from an initial bulk of 20x40x16 in. to 20x8x8 in., the briquettes weighing 1 to 1.5 hundredweight. Smelting of waste metal in this form is of course much more efficient and economical than to work up the loose material.

Zinc for Dry Cells. C. Drotschmann. *Chemiker-Zeitung,* Jan. 9, pp. 29-31; Jan. 16, pp. 50-2; Jan. 23, p. 72. The properties of sheet zinc for use in dry batteries must be such as to maintain the chemical efficiency of the cell and to carry the current without loss or leakage due to metal couples formed by impurities in the zinc. In refining zinc for this use, particular care should be taken to avoid inclusions of other metals. It has been found by experiment that the disturbing effect of lead is relatively small, but that arsenic is quite objectionable, particularly because it causes corrosion of the zinc when the cells are stored. Battery zinc should therefore be refined in such a way that it contains no arsenic and not much lead. Other impurities, particularly foreign metals, should also be excluded as thoroughly as possible.

Antimony. A. Short. *Metal Industry* (London), Jan. 11, pp. 39-42. For profitable mining of antimony, the ore must be either very plentiful or it must be easily mined. Many deposits are not worked merely because they cannot meet the competition of the favorably situated mines. The smelting method depends on the ore and its antimony content; low grade sulphide ores (20-30 per cent Sb) are generally fumed in a shaft furnace to form the trioxide, which is then reduced to metal in a small reverberatory furnace. Rich sulphide ores (50-60 per cent Sb) are reduced with iron (the English precipitation process) or roasted in a long reverberatory furnace and then smelted with soda ash. Statistics of the industry and uses of the metal and its compounds are cited, and a map showing world distribution of antimony ore deposits is shown.

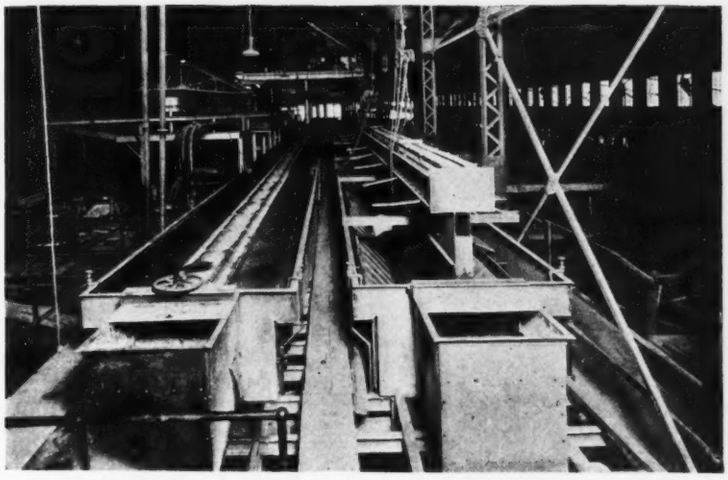
Radium. A. T. Parsons, *Journal of the Oil and Colour Chemists Association,* Jan., pp. 3-28. In view of the origin of radium, its ores are necessarily those of uranium. Since pitchblende of the Belgian Congo displaced American carnotite as the world source of radium, the price has decreased because the African ore (pitchblende mixed with a copper uranium phosphate and a lead silico-uranate) contains about 50 times as much radium per ton as the American ore. This ore is worked up at Oolen, Belgium. The radium is isolated by a complex series of precipitation, solution, and recrystallization operations. The quantities of ore, chemicals, and fuel used to produce one gram of metal run into hundreds of tons each. Uses of radium and its salts, chiefly in therapeutics and in making luminous paints, are described.

Chlorinating Sulphides. K. Braddock-Rogers. *Chemical News,* March 8; pp. 147-52. The method here reported for converting sulphide or selenide ores to metal chlorides is only a laboratory method, but is interesting in its possible implications. It is to heat the sulphide or selenide in a current of air and carbon tetrachloride vapor. When the process is carried out with pyrites, for example, the temperature used is just sufficient at first to volatilize the ferric chloride above the vessel; it is then increased to 450-500 deg. C. Trials of the method are reported with sphalerite, pyrites, chalcopyrite, cinnabar, bismuthinite, copper matte, nickel matte, and some selenides (berzelianite and zorgite). One telluride (altaite) was also tried. Analytical results are reported for these trials, and the method is recommended for certain analytical uses.

Copper Refining. W. Stahl. *Chemiker-Zeitung,* Feb. 16, 1929; p. 137. The existence of a eutectic of 96.5-96.6 per cent copper and 3.4-3.5 per cent cuprous oxide was demonstrated by Heyn in 1900. Detection of this eutectic in refining copper is not difficult; it occurs at that stage when nearly all the impurities have passed into the slag, and the oxygen content is about 0.8-1.2 per cent (oxygen content of the eutectic, 0.387 per cent). This is the stage at which it is customary to insert an alder pole in the molten metal, so that gases expelled from the wood will carry off any sulphur dioxide still remaining absorbed in the copper. This procedure causes partial reduction of the cuprous oxide, and soon the test samples begin to show a fibrous structure which gradually changes to a columnar appearance. This continues till the whole sample is coarsely columnar, the individual columns being perpendicular to the straight surfaces of the test piece. The peculiar formation was formerly attributed to the escape of gases from the molten metal; but analysis has now revealed that the columnar test pieces have the eutectic composition,—that is 0.35 to 0.39 per cent oygen and 99.61 to 99.68 per cent copper. Deviations above and below the true eutectic composition are readily understandable, because the sample would have to be taken at exactly the right moment to catch the pure eutectic.

Tantalum. G. M. Dyson, *Chemical Age,* March 2, Metallurgical Section, pp. 18-9. Tantalum is nearly always associated with columbium — namely, in tantalite, columbite, pyrochlor, yttrotantalite, and associated minerals. Tantalite, an oxide of tantalum, columbium, and iron, is the principal commercial source of the metal. There is also a large deposit of struverite, a titaniferous tantalum ore, which is an important potential source of both titanium and tantalum. For commercial production a grade of tantalite containing about 60 per cent of tantalum oxide and only a few per cent of columbium is selected. It is hand-picked, crushed, powdered, and fused with about two parts of potassium bisulphate. The melt is poured into water and the precipitate of impure tantalic and columbic acids is separated by sedimentation. After chemical treatments to remove tin, tungsten, and iron, the tantalum is precipitated as potassium tantalofluoride. This, by boiling with ammonia, filtering and igniting, yields the oxide. For large-scale production of the metal, the oxide is not a suitable starting material; the metal obtained is always very impure. The preferred method is to heat dry potassium tantalofluoride with dry potassium metal in vacuo in an electric furnace, compress the powdery metal to shape, and fuse it in vacuo by passage of a heavy electric current. Uses of the metal are described.

INDUSTRIAL PROGRESS



Two Miami-Dunn flotation cells recently installed in the concentrator of the Miami Copper Company

The Equipment Review

EQUIPMENT worthy of the attention of mining and metallurgical engineers and executives has recently been introduced by manufacturers. Of principal note is a new flotation cell, also some stoper drills, and a grab bucket for material handling by cranes and ore bridges.

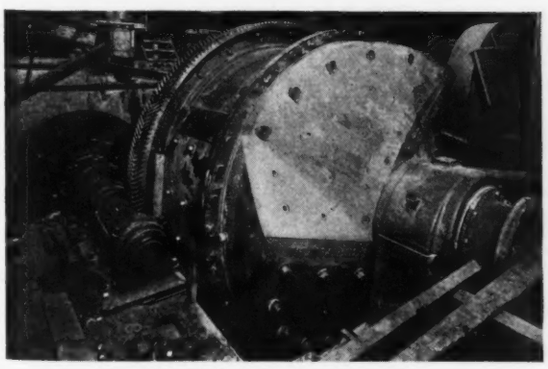
The Miami-Dunn Cell

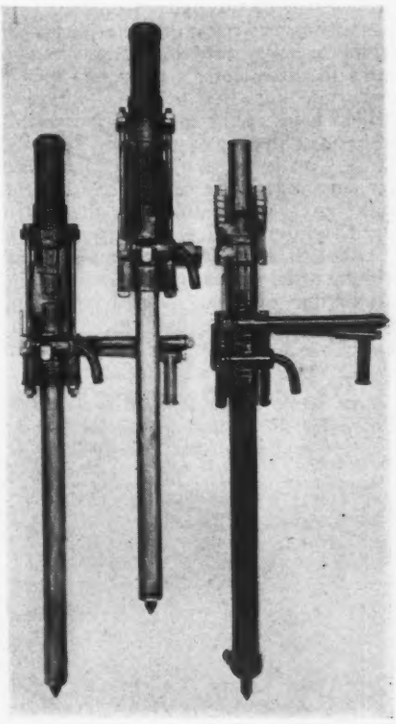
The new flotation cell, known as the Miami-Dunn cell, is shown in an illustration on this page. As its name would indicate, it was developed at the plant of the Miami Copper Company, operating in Arizona. It embodies several new ideas not hitherto put into practice, is simpler to install and operate than the older type of cells in use at the plant, and is also more efficient. In the illustration the cell on the left is shown in operation, and next to it in the center a similar cell is under construction at the point of having the central compartment lowered into the main box. To the right is shown a site being prepared for a third cell. These cells are 100 ft. long and have an air chamber, triangular in section, on each side, which is formed by the inclined inner bottom and the side and base of the cell. Air is kept at 1½-lb. pressure in this chamber, from which it is introduced into the bottom of the cell along its entire length through self-sealing slots. One cell has been in operation a little over a month. It treats 3,000 tons of flotation feed per day and makes a tailing of 0.06 per cent sulphide copper. This is thought to be the largest flotation cell that has been built to date. The concentrate from the last 66 ft. of the cells will be sent to 15-ft. cleaner cells, which will be installed on the deck now being constructed above the rougher cells.

The circular machine shown on the left side of the same illustration is a 28-ft. Dorr bowl classifier which has recently been installed. One of these classifiers and a rougher cell, a cleaner cell, and a 10-ft. by 8-ft. 6-in. Hardinge-Williamson mill, are being added to each of the six sections of the mill. The capacity of each section will thereby be raised from 2,000 to 3,000 tons, making Miami's total mill capacity 18,000 tons per day.

Some Interesting Rock Drills

In addition to the new improved stoper drill (the N-38) intended for fast cutting and severe service in hard abrasive rock, which the Ingersoll-Rand Company, New York, announced to the mining industries about six weeks ago, this company has just introduced two stoping machines, which are modifications of its "Jackhamer" drills. These "Jackstopers," as they are known, are self-rotated machines. They were developed and perfected to fulfill the demand and need for light, self-rotated drills for general stoping, raising and ring-drilling purposes. They are designated by the symbols R-39 and S-49 and are modifications of the "Jackhamers" of the same symbols. With the addition of these drills to its line, the company now has, together with its powerful R-51 drill, an automatically





At the left—Note the end of this Hardinge-Williamson mill which has been added to the flow sheet of the Miami concentrator (see text above). Right—Three new rock drills, the R39 and S49 self-rotated "Jackstopers" and the N38 "Stopehamer," from left to right respectively.

rotated stoper for any class of stoping operations.

Emphasis is laid on the fact that these "Jackstopers" are not merely "Jackhamer" drills turned upside down with an air feed added. Instead, they are machines in which necessary changes in design have been made and to develop which extensive experimentation and exhaustive testing were conducted before the machines were put into production and offered to industry. The changes in design referred to include new cylinders, anvil block, fronthead, and the company's standard air feed with push-button control. Rotation is effected by the well-known "Sargeant" rifle bar and ratchet mechanism. The exhaust is directed away from the operator and down toward the air feed end of the drill.

The valve is of the "flapper" type, the same as used in the "Jackhamer" drills, and is completely inclosed in the back end of the cylinder. This gives the valve complete protection at all times and allows the machine to retain stream lines. Details of the "Jackstopers" are as follows:

	R-39		S-49	
Weight	81½	lb.	85	lb.
Bore	2⅜	in.	2⅜	in.
Stroke	2	in.	2¼	in.
Length of feet (closed)	54⅜	in.	55⅛	in.
Length of feet (extended)	79⅛	in.	81¼	in.
Total feed travel	25⅜	in.	25⅜	in.
Diameter of air feed	2	in.	2	in.

Trolley Guard Board Hanger of Dual Application

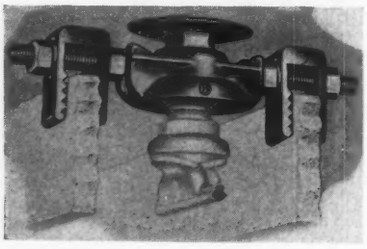
A new type of mine hanger which has a dual application has just been placed on the market by the Ohio Brass Company, Mansfield, Ohio. This new hanger (incorporating all the advantages found in the company's Universal-5 hanger) serves to insulate the trolley, and at the same time affords an easy and quick method of supporting the guard board.

The shell of the hanger is slotted on two sides for engaging the heads of half-inch bolts. By inserting the bolt heads in these slots, a rigid and secure anchorage for the bolts is obtained. Drilled holes in the guard board permit direct attachment; or specially designed clamps, made by the above-mentioned company, which are suspended from the bolts, may be used to clamp the guard board tightly in place.

Although this new hanger is being manufactured primarily to facilitate the installation of new guard-board construction, it can be used to great advantage as a regular line hanger where the installation of guard-board protection is contemplated at a later date. Guard board then may be installed at any time without difficulty, as hangers especially adapted to supporting it are already on the line.

The hanger body has a 3¼-in. diameter shell, 2 in. high, and is made of O-B Flecto iron, hot-dip galvanized. Corrosion will not affect the assembly, as no holes are drilled in the hanger shell; the assembly merely slips into the cored slots on the hanger. The hanger is insulated with O-B Dirigo insulation and is regularly furnished without petticoats to facilitate cleaning.

New trolley-wire hanger installed, showing use of attachment for supporting guard boards



Something new in grab buckets—the so-called "Polyp." Its multiple flexible blades operate independently.

A Grab Bucket of Novel Design Developed in Germany

A radical departure from hitherto known designs of buckets is represented by the so-called Polyp bucket, manufactured by Reichmann-Becker Polyp Company, Duisburg, Germany. As indicated in the accompanying illustration, the Polyp may be termed a multiple flexible-blade bucket, the blades being not rigidly connected with one another, but operating independently. They adjust themselves in every way to the material to be handled and dig themselves in like so many fingers of a hand. The bucket is built in two types. The open type is used for handling steel scrap of every kind and other similar material, and the closed type is designed for handling ore, coal, coke, gravel, sand or stone, in excavation work, dredging, and similar operations.

The principal advantage is that the bucket takes a full load with each lift, which increases the efficiency of the plant, as less labor need be employed. The Polyp is built from the smallest size up to a capacity of 20 cu.yd. Although this new bucket has been on the market but a few years, numerous units are now used in Europe. Patents have been granted and others are said to be pending.

Clean Lamps for Dirty

Development of a practical method for removing the black deposit which gradually collects on the inner surface of high-powered incandescent lamps has been announced by the General Electric Company's lamp development laboratory at Cleveland, Ohio. Bulb blackening has always been a significant factor in determining the useful life of all incandescent lamps, and, owing to the large filament in high-intensity gas-filled lamps, this factor has been most important. The rising gas in such a lamp carries evaporated tungsten with it, which is deposited on the cooler top and sides of the bulb. This "soot" absorbs considerable light and radiates heat. In time the glass undergoes devitrification and finally becomes so hot that the bulb becomes ill-shaped and useless. The new deposit-remover is nothing more than a tablespoonful of coarse tungsten powder, placed inside the lamp before it is sealed. After the lamp has become blackened from use, the operator needs but remove it from its socket, invert it, and "sweep" the filament deposit off the inner glass surface, thereby restoring the lamp to its former efficiency. This method of cleaning the inside of the bulb has been applied to several high-intensity lamps.

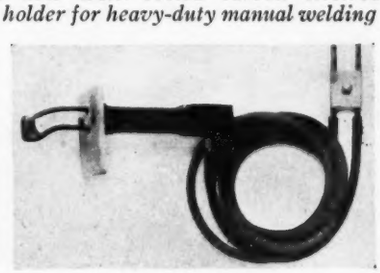
A New Relay for Alarm Circuits

General Electric has also introduced a new relay for use on various types of alarm circuits. This is of the normally closed type and functions to actuate a warning signal on the failure of power. It is strongly and simply built and operates quietly. The contact is of the silver-to-silver type and is double-break. The relay is made in standard ratings. It will be applied in various ways, the company expects. The warning signal controlled may be of any customary type.

Some New Floodlights

A new line of floodlighting projectors has been introduced by General Electric. The projectors have non-rusting casings, and the glass reflectors and lamps are totally inclosed, so that dust and dirt cannot enter or impair efficiencies. The casing is non-ferrous, affording good heat radiation and permitting minimum dimensions. Ease and accuracy in focusing are attained through the use of a special mechanism. The projectors are built with a formed, single-piece sheet copper casing and a single-piece door of the same material. Lenses of heat-resisting glass are available in

A new water-cooled carbon electrode holder for heavy-duty manual welding

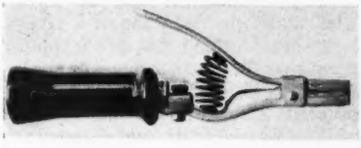


two sizes. Three types of projectors are included, one being designed primarily for use with a 250-watt floodlighting lamp and intended for working at distances of 85 to 200 ft. The other two are intended primarily for use with 500-watt and 1,000-watt lamps respectively. These may be had with different reflectors, permitting the angle of the beam to be varied, thus controlling the distribution of light.

More Welding Accessories

The prevailing widespread use of welding makes it possible for the manufacturers of welding equipment to find a ready market for the numerous accessories and devices that are constantly being introduced for this service. Devices recently introduced include the following:

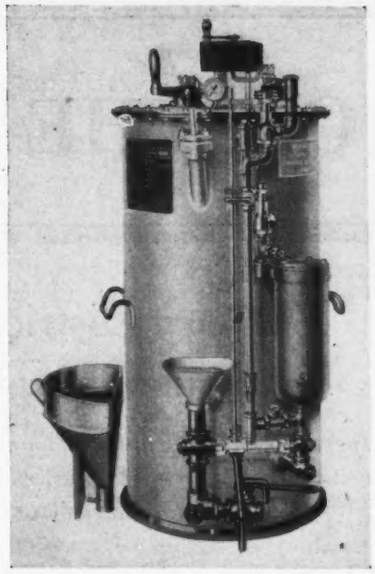
The Lincoln Electric Company has perfected a new type of water-cooled carbon electrode holder for heavy-duty manual welding by the carbon-arc process. (See p. 688.) This was designed primarily to insure greater comfort and less fatigue for the operator, but has been found also to effect a marked economy in the use of carbon electrodes. It is shown in one of the accompanying illustrations. Because of its efficient design the holder makes it possible to weld with the arc tip of the carbon electrode projecting less than 3 in. from the holder. In consequence, a smaller carbon area is heated, so that the vaporization of the carbon is reduced. Consequently, it is possible to use a smaller size of carbon with higher current



An improved electrode holder for metallic arc welding

density, thus effecting a decided saving in the cost of electrodes. The new holder has a weight of only 3¼ lb., in the operators' hands. One of its unique features, which contributes to the light weight, is the use of the hose which carries the water for carrying the cable also, the water being thus used as a cooling agent for the cable. The size of cable to the holder is reduced by this means to a fraction of what would be necessary were it not used. The carbon holder consists of a coiled copper tubing through which water constantly circulates, the carbon electrode being inserted through the coil.

The same company has introduced an improved type of electrode holder for metallic arc welding, which is also designed to give greater convenience to the operator. This holder consists essentially of a powerful clamp to hold the welding electrode firmly during the welding. It is designed to permit easy release, so that the electrodes may be changed quickly. The handle grip may be easily held and is exceptionally cool, because the welding current is carried



A medium-pressure acetylene generator for stationary or portable use recently introduced

from the point of cable entry to the copper jaws of the holder by copper strips of low resistance. Thus uncomfortable heating is avoided. The copper tips on the jaws reduce the sticking of the electrode to the jaws. The shape of the holding clamps has also been altered to give greater compactness. This makes it possible to use the holder on work in close corners.

Two new appliances have been introduced by the Oxweld Acetylene Company, New York City. One of these is a medium-pressure acetylene generator especially designed for stationary or portable use in connection with either medium-pressure or low-pressure welding-and-cutting blowpipes. This generator is adequate for any type of welding or cutting operation, and can easily be carried from place to place on a truck or wagon. Its capacity for carbide is 30 lb., the quarter-size carbide being used. The weight of the generator empty is 305 lb.; full it is 623 lb. The outstanding characteristic of the design of the device is strength and simplicity, making it practicable for use under varied conditions.

An improved bronze-welding rod has been introduced by the same company, which recommends it for all bronze-welding applications, including the fusion welding of brass and bronze, bronze-welding of malleable and gray-iron castings, the joining of dissimilar metals and the building up of bearings and other wearing surfaces. By its use, tough and ductile weld metal having a tensile strength of over 45,000 lb. per square inch can be produced, this being about 15,000 lb. per square inch in excess of the strength obtainable with the earlier bronze welding rods. The makers claims that it will also make a much stronger bond with ferrous metals. The new product is designated as the Oxweld No. 21 high-strength bronze welding rod.

INDUSTRIAL NOTES

Frank D. Taylor, for many years secretary and director of sales of the Peck, Stow & Wilcox Company, has now become associated with the Trimont Manufacturing Company, Inc.

The Stearns-Roger Manufacturing Company, of 1720 California St., Denver, announces that it will hereafter act as agents in the Intermountain district for the Chicago Pneumatic Tool Company, of New York.

The American Askania Corporation, of Houston, Tex., has recently acquired the right to sell all instruments and apparatus of the Askania Werke A.-G., Bambergwerk, Berlin-Friedenau, Germany, in the United States.

The American Hoist & Derrick Company, 63 South Robert St., St. Paul, Minn., announces the appointment of A. R. Gelinas as its agent for Ontario, Quebec, and the Maritime Provinces of Canada. Mr. Gelinas's office in Montreal is in the McRitchie & Black Building, Montreal.

The Western Machinery Company, of Salt Lake City, Utah, and the Machinery Sales Agency, of San Francisco, with branches at Los Angeles and Phoenix, Ariz., are now consolidating their interests and will be known as the Western Machinery Company. Both companies have been controlled by the same financial interests, and it was thought the handling of the business would be simplified and the trade better served by placing the entire organization under one name.

BULLETINS

COMPRESSORS—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 83-L, Diesel driven angle compound compressors. Twenty pages.

PROTECTIVE PAINTS—American Wurtzilite Company, Builders Building, Wacker Drive, Chicago, Ill. Five-point Wurtzilite paints, coatings, and binders. Eight pages.

ASBESTOS—Canadian Asbestos Company, 316-322 (old No. 42-48) Youville Square, Montreal, Quebec, Canada. Handbook and catalog No. 1733, first edition. Canasco products. Two hundred and twenty-four pages.

LABORATORY BALANCE—The Thompson Balance Company, Denver, Colo. Illustrated catalog No. 29, high-precision balances and weights for scientific purposes. Thirty pages.

ELECTRICAL FIXTURES — Crouse-Hinds Company, Syracuse, N. Y. Bulletin No. 2129, vapor-proof industrial fixtures. Eight pages.

ELECTRICAL FIXTURES — Crouse-Hinds Company, Syracuse, N. Y. Bulletin No. 2121, Arktite circuit-breaking plugs and receptacles. Thirty-six pages.

TRANSFORMER OIL—Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin No. 162, discusses the purposes of transformer oil, its properties, methods of testing, precautions when handling, and storing. Eight pages.

NEWS OF THE WEEK

Summary

BROADENING of the market for zinc was the central theme of discussion at the St. Louis meeting, held last week. Theodore Marvin presented a report in which he suggested that about $300,000 a year be devoted by the industry to this purpose. Page 691.

* * *

Operations at the Star mine, of Sullivan Mining, which is expected to be the chief source of supply for the new Sullivan electrolytic zinc plant, will be increased to 450 or 500 tons daily within the next few months. Page 694.

* * *

Shipments have been started from the Blueberry mine of the Ford Motor Company, on the Marquette iron ore range. Page 693.

* * *

Bagdad Copper will build a 3,000-ton concentrator at its mine, near Hillside, Ariz. Page 694.

* * *

Newmont Mining has taken over the Empire gold mine, in Grass Valley. This property has been producing steadily since 1851 and was privately owned. Page 691.

* * *

The John Fritz medal was awarded to Herbert Hoover in Washington this week by representatives of the various engineering societies. Page 695.

* * *

Firing of the largest blast ever fired in the Lake Superior district was successfully accomplished on April 18 at the Volunteer mine, of Pickands, Mather & Company. About 600,000 tons were loosened. Page 693.

* * *

A Los Angeles syndicate has acquired the Blue Ledge mine in northern California from American Smelting & Refining and plans immediate reopening of the property, which is 40 miles from Medford, Ore. Page 692.

Sudbury District Reflects Growing Demand for Nickel Products

Operations at International Company Properties Now at Full Capacity, and Exploration Activities by Small Companies Continue—Agnew Announces Construction of Nitre Cake Plant

MINES and smelters of International Nickel, at Sudbury, Ont., including those acquired in the recent consolidation of Mond Nickel with International, are operating at full capacity as a result of the excellent market for nickel and mill products. This growing demand is also reflected by the continued activity in prospecting and development work throughout the Sudbury district. With three mines—Creighton, Levack, and Garson—working on a greater production basis than at any time since the close of the World War, and with every wheel turning at Copper Cliff and Coniston, where the reduction plants are situated, International is straining its energies to keep pace with the demand, which continues to grow rapidly and which is estimated to have increased over 100 per cent during the last year.

At the adjourned meeting of shareholders on April 19, John L. Agnew, vice-president of the company, announced that a contract had been consummated with Canadian Industries, Ltd., whereby the latter will construct a chemical plant at Copper Cliff to manufacture nitre cake, which is a necessary flux in nickel refining. Part of the sulphur fumes from the new smelter now under construction at Copper Cliff will be used in the manufacture of nitre cake. The contract calls for a sufficient supply throughout a period of ten years, and is renewable on favorable terms.

At the same time Mr. Agnew also announced that American Metal is associated with International Nickel and Consolidated Mining & Smelting in the incorporation of the Ontario Refining Company, which will undertake the erection of the refinery at Sudbury, of which announcement was made some time ago. International Nickel has been selling its copper output to American Metal for refining at the latter company's plant at Chrome, N. J., under a long-term contract. This contract has been assigned to Ontario Refining.

In a statement issued from his office at Copper Cliff, Mr. Agnew announced last week details of the personnel of the staff of the company, following the reorganization and consolidation with Mond Nickel. J. C. Nicholls remains as general manager of the entire company's operations, which have been divided into three divisions. These are (1) the mining division, which includes all mines of both companies, and will be under the direction of Oliver Hall, as general superintendent; (2) the smelting division, which will include operations at Copper Cliff, Coniston, and the power plants, under the direction of Donald MacAskill, as general superintendent; and (3) the refining division, with operations at Port Colborne under the direction of H. W. Walter, as general superintendent, and at Clydach, Wales, under the direction of J. Gregory. W. A. MacDonnell has been appointed manager of the Coniston smelter. E. A. Collins and C. E. MacDonald have been appointed assistants to the vice-president at Copper Cliff and Toronto, respectively. No changes have been made in the personnel of the various mines and smelters of the company.

Indicative of the interest being taken in nickel-copper mines, a reliable estimate places the number of claims that have recently been staked in the Sudbury district at from 2,000 to 2,500. On all of these assessment work will fall due in the middle of July. Among the largest holdings on which work will soon be started are those of Mining Corporation, with 235 claims; Sudbury Nickel & Copper, with drills already operating on two groups and with total holdings estimated at almost 350 claims; McVittie-Graham Mines, at present working at Moose Lake and with holdings aggregating about 300 claims; and Ventures, Ltd., with a total of about 500 claims, apart from its interest in Falconbridge. In addition, of course, there are numerous smaller outfits and a large number of individual claim holders who will perform their first year's assessment duties before allowing their claims to revert to the Crown.

This year's activity in nickel-copper prospects is expected to exceed last year's boom in the search for lead-zinc-copper deposits in the interior of Sudbury Basin.

Broadening of Its Market Is Theme of Zinc Institute at Annual Meeting

R. M. ROOSEVELT, president of the American Zinc Institute, in convening the eleventh annual meeting of the organization at St. Louis, on Monday, April 15, stated that the purpose of the annual gathering was to discuss those things that had not been done by the organization and not those things that had been accomplished, and that he expected the meeting to be a business session and not a chautauqua. Such it proved to be, and the thing that the industry has failed to do—the establishment of a research department for the broadening of the zinc market—came in for its full share of discussion.

Preliminary arrangements called for the welcoming of the delegates to St. Louis by W. B. Weisenburger, president of the St. Louis Chamber of Commerce, and the address in reply by E. H. Wolff, of Joplin, Mo. With the preliminaries out of the way, the real business of the convention was begun with an address by William E. Humphrey, commissioner of the Federal Trade Commission, who outlined the policy being pursued by that body toward business. His message conveyed the thought that an industry, such as the zinc industry, could do certain specific things as a group to promote the welfare of the industry and at the same time preserve the rights of the public.

"Business of Getting Together"

At the Monday afternoon session, Chester Leasure, of the U. S. Chamber of Commerce, Washington, spoke on "This Business of Getting Together." He stated that a trade association was a laboratory and a forum; that business groups through associations have a signal opportunity to get together and stay together for their mutual benefit.

Two papers, dealing with what had been accomplished in the last year, on subjects that hold a vital interest to the industry, were also read at the afternoon session. "Our Traffic Problems" was the title of a paper prepared by W. A. Moore, chairman of the general traffic committee. The paper was read by H. A. Gray. The second paper, "Tariff Readjustment, 1929," was read by Stephen S. Tuthill, secretary.

Funds Wisely Spent

After these papers were read, Mr. Roosevelt turned the meeting into a committee of the whole, for the discussion of any problem the members thought advisable. Mr. Roosevelt read the financial report, showing a deficit for the year of about $16,000, which almost dissipated the funds of the organization. He took full credit for the spending of the money, declaring that several matters that had been put off from year to year—such as the publishing of the Zinc Workers' Handbook—were accomplished. The organization could go ahead as in former years on present revenues, but to progress a great amount of money was required. He suggested that to raise more money a spirited membership drive be made.

Members of the Institute congratulated Mr. Roosevelt for the work he had done during the last year, and heartily agreed that the money disbursed had been well spent. They expressed a hope that the finance committee would make every effort to provide sufficient funds to carry out the work.

At the opening of the Tuesday morning session, the retiring directors—Mr. Roosevelt; B. N. Zimmer, of the American Metal Company; Edward Furst, of the Grasselli Chemical Company; Benjamin Lissberger, of the United Zinc Smelting Corporation; John W. Newton, of the Commerce Mining & Royalty Company; Edgar L. Newhouse; Arthur Thatcher, of the New Jersey Zinc Company, and F. C. Wallower, of the Evans-Wallower Lead Company—were re-elected.

Research Value Stressed

Dr. L. D. Redman, director of research of the Bakelite Corporation, spoke on "The Value of Research," in which he showed what an industry can do by research work and what he thought it was possible for the zinc industry to do by research efforts. "Technique of Industrial Sales and Advertising Research" was the title of a comprehensive and interesting paper delivered by Malcolm McGhee, industrial marketing counselor of the McGraw-Hill Publishing Company.

The real purpose of the convention, to come to some understanding on the research and market broadening program, was covered in a report of the market-broadening division, made by Theodore Marvin, in which it was suggested that a sum not to exceed 50c. a ton on all metal, or its equivalent, be raised for the promotion of a research and market broadening program. Under present production capacities such an assessment would make available approximately $300,000 a year for research and advertising. He suggested that $50,000 be made available at once for a market survey. The members approved the suggestion and authorized its submission to the board of directors for further action.

The directors at the afternoon session instructed Mr. Roosevelt to appoint a committee to work with Mr. Marvin, to the end that a definite proposal could be made to the members of the industry for their approval. If the members of the industry will approve the plan suggested, and further agree to carry on for a definite number of years, the Institute will start immediately on a vigorous research program.

All of the present officers, including Mr. Roosevelt, A. P. Cobb, P. B. Butler and John A. McCarthy, vice-presidents, Howard I. Young treasurer, and S. S. Tuthill, secretary, were re-elected at the meeting of the board.

The board accepted the resignation of John W. Newton and appointed John A. Robinson, of Miami, Okla., to his place. The board also voted to discontinue the publication of the Bulletin for the time being.

At the Wednesday session Dr. Charles Camsell, Deputy Minister of Mines, Department of Mines, Canada, pictured the zinc industry in that country. A paper, "Fine Grinding in the Tri-State," read by W. H. Coghill, of the U. S. Bureau of Mines, closed the convention.

The usual smoker was held on Monday night and the annual banquet on Tuesday night. Strickland Gillilan was the principal speaker at the banquet.

Newmont Buys Empire, Gold Producer Since 1851

ON APRIL 18, announcement was made that the property of the Empire Mines Company, at Grass Valley, Calif., of which the principal stockholder is E. B. Bourn, has been sold to the Newmont Mining Company. Newmont will take possession on May 1. The mine is one of the few historic mines in California that has consistently maintained its production from its discovery in 1851 to the present. Under the able management of George W. Starr for the last 30 years, exploration, development, and production have been balanced so skillfully that a steady stream of gold has resulted. The mainstays of Nevada County gold production have been the North Star and the Empire mines. The terms of sale have not been made public.

Iron Mountain Mill Is Nearing Completion

At Iron Mountain, Shasta County, Calif., the Mountain Copper Company has about completed its flotation plant, and mining of ore from the No. 8 mine for the mill has been started. The daily capacity of the mill is 350 to 400 tons. The same company is operating the Hornet mine, which continues to produce a pyrite ore used by sulphuric acid plants.

Two Die at Idaho-Maryland

Two men, John Gorman and Ray Harris, were killed at the Idaho-Maryland mine, Grass Valley, Calif., on April 15, when a trestle upon which an ore train had been backed collapsed. Both men were employees and were operating the train between the skip pockets in the headframe and the mill near by. The trestle had not been in use, and the ore train had been backed upon it for the purpose of making minor repairs.

A. S. & R. Sells Blue Ledge to Los Angeles Syndicate

SALE of the Blue Ledge copper mine, 40 miles from Medford, Ore., the nearest shipping point, to a Los Angeles syndicate headed by J. B. Roof and B. F. Miller, Jr., has been made by American Smelting & Refining. Dr. J. F. Reddy, of Medford, represented the syndicate in the transaction, which is said to involve more than $500,000. Reopening of the mine immediately is planned, as well as installation of a new flotation plant.

The Blue Ledge is 4 miles south of the Oregon-California state line, in Siskiyou County. During the war the mine was a shipper to the Tacoma smelter, but it was closed down in October, 1920, and has been idle since. At that time, nine tunnels had been driven and the total amount of development work was more than 2 miles. The ore is mainly chalcopyrite, associate with a little sphalerite and occasional native copper. Average grade is said to be about 6 per cent copper.

The property was formerly owned by Mexican Smelting & Refining Company, a subsidiary of the Compañia Metalurgica Mexicana, which passed into control of A. S. & R. late in 1923. A 40-mile railway to connect with the Southern Pacific at Medford has been considered several times, but no steps to this end have yet been taken.

Activity in Channel Mining Near Vallecito, Calif.

AT Vallecito, Calif., active interest is being taken in exploration and development of Tertiary river channels. Vallecito Western Mining is making plans to sink a second shaft upon the channel which it has developed during the last five years. The new shaft will be used for mining gravel now exposed and also to serve for exploration and development upon the extension of the channel at Six-Mile Creek.

Not far distant Butte Mining is sinking a shaft for exploratory purposes. Victor Land & Mineral, near Angels Camp, is extending its development and the Calmo, on the same channel, is continuing with exploration. The Douglas Flat Mining has sunk its shaft 90 ft. to bedrock. Successful development of Vallecito Western Mining has stimulated interest in the search for further extensions of known channels.

Will Build 50-Ton Mill at Edith Mine

Construction of a 50-ton mill at the Edith mine, near Murray, Idaho, in the Coeur d'Alene district, will be undertaken by the Pontiac Land & Mineral Company, which owns the property. Ore shipments from the mine have been started recently. As the company has considerable crushing equipment on hand, flotation machinery will be the only additional equipment needed and consequently construction of the plant is expected to be completed within three months.

Regal Asbestos Completes Mill at Chrysotile, Ariz.

REGAL ASBESTOS has completed the erection of its mill at Chrysotile, Ariz. A feature of the new plant is that it eliminates the necessity of hand-cobbing the crude asbestos. In perfecting the mill, numerous problems were solved only after months of experimentation in Eastern laboratories.

One of the new machines separates the crude No. 1 and No. 2 asbestos much more accurately than has hitherto been possible by hand sorting. In addition to the two crude products, three grades of clean spinning fiber and a high-grade shingle stock are produced. Several other shorter grades of fiber will also be produced if this is found feasible.

The mill is electrically operated and receives its power from two generators, each of which is driven by a Diesel engine.

Ancho Now Milling About 1,000 Tons Monthly

The Ancho property of Yellow Tiger Consolidated Mining Company, in Nevada County, Calif., is operating ten stamps and milling about 1,000 tons per month. Efforts are being made by operators on Washington ridge, in Nevada County, to secure the installation of a power line from the Deer Creek power house of the Pacific Gas & Electric Company. The properties which will be served include the Eagle Bird, Ancho, Gaston, and Twin Sisters.

Butte Independent Hits Ore

Butte Independent Mines Company, one of the first companies to operate in the Ardsley, or southwest, district of Butte, Mont., has encountered 1 ft. of solid lead-zinc sulphides, in a 4-ft. vein, about 400 ft. north of its Canadian shaft, this ore being opened on the 325 level. The ore is now being drifted on to the east.

Tamarack Gold Mine, Near Sheridan, Mont., Is Bought

Alex Leggat, Butte mining man, has purchased the Tamarack gold mine, near Sheridan, Madison County, Mont. This property has been worked on a small scale for many years. At present there is a small amalgamation-concentration plant on the ground. Two tunnels which have been driven on the property will be extended, and development work started immediately, according to Mr. Leggat.

Basin Montana Reported to Have Struck High-Grade Ore

ACCORDING to items appearing in the Butte newspapers, one of the most important developments in the Basin district is the opening of high-grade copper-silver ore in the Grey Eagle property of Basin Montana Tunnel, about 4 miles northeast of Basin, Mont., where 30 men have been employed opening the property for the last ten months. The Grey Eagle vein is an extension of the Comet, which produced about $13,000,000 in lead-zinc-silver recoveries, and which is now producing about four carloads of ore per week. The Grey Eagle has produced about $2,000,000 of the same grade, but very little copper has been found on the Comet vein until the recent find.

This copper ore, consisting of chalcopyrite and tetrahedrite, is north of the lead-zinc-silver vein. It was first encountered on the 400 or tunnel level of the Grey Eagle and also has been opened in workings from a winze 200 ft. below that level.

Basin Montana Tunnel Company controls 84 claims, extending about 3 miles south of the Grey Eagle group. The southern claims of the company carry considerable copper ore, but copper has never been the predominating metal in the northern section. Samuel J. Barker, Jr., managing director of the company, is now making a geologic study of the new occurrence. As soon as the roads are put in condition, after the snow melts, shipments will start from the Grey Eagle property. This is expected to be about May 1.

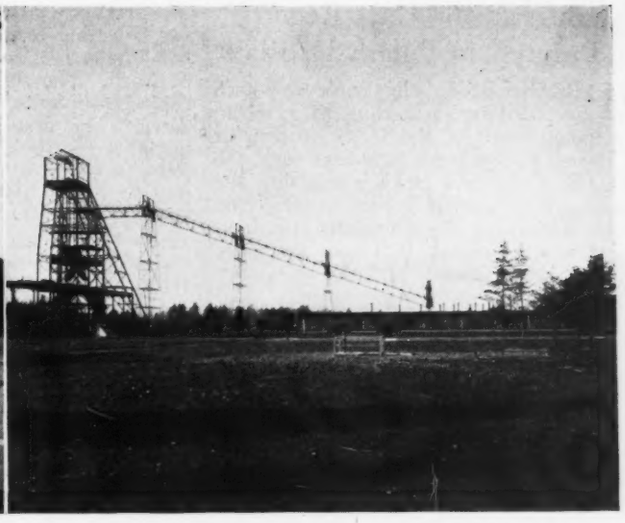
F. M. Connell Options Property on Worthington Offset

A Smith & Travers diamond drill was shipped this week from Sudbury, Ont., to begin exploratory work on Lot 12, Concession 3, Township of Denison, known as the Gersdorffite "location," which has been optioned from its owner, J. T. O'Connor, by F. M. Connell and associates, a cash payment of $5,000 having been made on an option price of $150,000.

The property to be drilled is one of a string of old locations on what is known as the Worthington "offset." A company, known as Denison Copper Mines, has two drills at work on the Robinson "location" adjoining the Gersdorffite to the north.

Montana Premier Formed

G. T. Letterman, Harvey H. Phipps, and John Blossom, of Spokane, recently incorporated the Montana Premier Gold Mining Corporation to take over and operate a property near Plains, Mont. The company recently ordered compressed-air equipment from the Sullivan Machinery Company.



Single unit housing various surface departments *Steel headframe and shieve stands*

The Blueberry mine, on the Marquette range

Ford Motor Starts Shipping From Blueberry Mine

THE BLUEBERRY mine of the Ford Motor Company, on the Marquette iron ore range, which has been in the development stage for two and a half years, entered production this month. Ore now being hoisted to surface is coming from the main drifts, no stopes having been opened as yet. The company expects to ship 40,000 tons from the property this year. Ford's Imperial mine, on the same range, will ship 25,000 more tons in 1929 than in 1928. These are the only two iron-ore mines worked by the company.

In the open market the Ford company has contracted for 77,000 tons of manganiferous ore, 33,000 tons of siliceous, 44,000 tons of high phosphorus, and 180,000 tons of hematite. The order was placed with four producers and the regular market price was paid, this being 25c. a ton more than the schedule of last year. Considerable scrap will also go into the River Rouge furnaces.

Blast at Volunteer Mine Set Off on April 18 Successfully

THE LARGEST MINE BLAST ever set off in the Lake Superior district was fired on Thursday afternoon, April 18, in the Volunteer pit of Palmer Mining, subsidiary of Pickands, Mather & Company, on the Marquette range. A charge of 212,000 lb. of dynamite loosened approximately 600,000 tons of iron ore, most of which will be loaded by power shovels and shipped this summer by rail and water.

During the winter months 635 church-drill holes, 5-in. in diameter, were put down on two benches. On the lower bench were 514 holes, averaging 44 ft. in depth; the remainder, on the upper bench, averaged 58 ft. The powder employed was 40, 60, and 80 per cent gelatine, and 10 miles of Cordeau-Bickford fuse were used. A single cap in a stick of powder, connected to a battery, detonated the charge.

Engineers present state that the "shot" was a complete success. The mass of ore was well broken and can readily be handled by the large electric shovels. Very little block-holing will be necessary. Three motion picture cameras recorded the event, and engineers from the Mesabi range were on hand to record the vibration, which was figured at one-quarter of an inch less than half a mile distant. The powder cost was said to be in excess of $30,000; the drilling cost, $75,000.

Large blasts are now the practice in all of the siliceous ore pits on the Marquette range, one of 20,000 lb. having been set off during the same week in the new Tilden mine pit of Cleveland-Cliffs, breaking almost 100,000 tons.

Champion Resumes Drilling on Its Exploratory Tract

DIAMOND drilling has been resumed in the Champion Copper exploratory tract in the South range district of the Michigan copper country. Two new holes have been started in the horizon of the Ashbed series. No further work will be done in the first two holes. Both of these indicated copper in the Ashbed, but in hole No. 1 no copper was found in the Pewabic bed, which was cut at a depth of about 1,500 ft. The second hole was not driven to the Pewabic. Additional holes will serve as a check on the continuity of mineralization in the Ashbed.

At the Copper Range mines, production has been increased somewhat. Champion continues to make a good showing, and Trimountain and Baltic are doing a little better on account of the higher price of copper. Flotation is being experimented with in the mill. Temporary equipment is being tried out to ascertain the most suitable process for Copper Range ore and conditions.

Will Hasten Development at Carp Lake Property

DEVELOPMENT of the Carp Lake property, in the Porcupine Mountain district in Ontonagon County, Mich., is progressing satisfactorily. More men will be employed and the work will be speeded. A conglomerate sandstone, carrying seams of copper, is being opened. A working tunnel has been driven 1,200 ft. south into the side of the mountain, at a depth of about 800 ft. from the apex. From the tunnel level, two drifts, one to the east and the other to the west, are being opened. Good copper ground has been disclosed in both. The west drift is being extended toward an old pit, about 240 ft. from the point now reached, which formerly disclosed some ore. The east drift is proceeding toward the old East shaft. About 270 ft. of drifting must be done before reaching a point directly below these old workings. Ore taken from the second level of the old shaft has been given a series of flotation tests which show that the fine copper in the Carp Lake lode can be successfully recovered.

Good Showing in New Area Near No. 1 Seneca Shaft

AT SENECA, in the Michigan copper district, a significant copper showing is being opened in virgin ground by the long No. 3 level north drift from No. 1 shaft. This opening is below and well beyond No. 2 shaft. The drift is in a horizon 200 ft. below the deepest openings of North Mohawk and deeper also than both of the old Ojibway shafts. This is territory not heretofore tapped, and in a zone that is comparatively little known. The continuity of the grade of ore in the drift in this section of the property will probably have an important effect on the future of the mine.

Sufficient rock is being shipped to the mill to keep one stamp head in operation.

Bureau of Mines Reports Progress in Potash Drilling

PROGRESS is being made on potash test drilling, according to a recent announcement of the U. S. Bureau of Mines. Twelve holes have been sunk, the U. S. Geological Survey selecting the sites and analyzing the cores and the Bureau of Mines making the drilling arrangements. Three of the holes are in New Mexico and the remaining nine are in southwestern Texas. All show potash deposits, mostly polyhalite, at numerous horizons, and some of the beds are reported as of sufficient thickness to be of commercial interest.

The twelfth hole, at Leeman Ranch, in Winkler County, Tex., has been put down 1,100 ft. to the top of the salt deposit wherein the potash beds occur. Cores are taken through the salt, which has been found in other holes to be 500 to 1,000 ft. thick. The hole in progress will go down about 2,300 ft. and will be the deepest yet made in the investigations.

Pan Inyo Shipping Complex Ore to Midvale

PAN INYO Mining, operating in Inyo County, Calif., in the Panamint range, on the west side of Death Valley, has opened up 5 ft. of sulphide ore in its shaft, at a depth of 195 ft. The ore assays 3½ oz. of gold and 10 oz. of silver to the ton, 12 per cent zinc, and 5 per cent lead. An International truck has been purchased to haul the ore to Trona, the nearest shipping point, 40 miles distant, for consignment to the Midvale smelter of U. S. Smelting Refining & Mining.

Comanche Mining & Reduction Company, operating near Bishop, Calif., in the Blind Springs Hill district, is preparing to ship to Midvale, Utah, by way of Benton.

Utah Copper to Build 38 New Houses at Copperton

CONTRACTS for the construction of 38 new brick and stucco homes at an average cost of from $5,000 to $6,000 each have been awarded by Utah Copper. When completed, the total number of model homes at Copperton, Utah, at the mouth of Bingham Canyon, near Salt Lake City, will have been increased to 115. These new bungalows will be model throughout. Copper roofs and other copper fixtures will be used. Homes will be arranged so that lawns and shrubbery can be planted, according to L. S. Cates, general manager of the company.

A. S. & R. Drilling Ground Near Chino Mines

Diamond drilling on several claims in the Central mining district, Grant County, N. M., is now being done by Continental Diamond Drilling, under the direction of H. S. Turbush. American Smelting & Refining acquired control of the properties in the early part of April. The claims adjoin the Chino copper properties of Nevada Consolidated. The first hole is being drilled in the bed of Gold Gulch Creek, on the Roos property, at a point 450 ft. from the outcrop of the main vein. Power will be obtained from the line of the Texas Louisiana Power Company, with which connections are now being made. Julius Kruttschnitt is representing American Smelting & Refining.

Work Old Mines in Free Coinage District, Utah

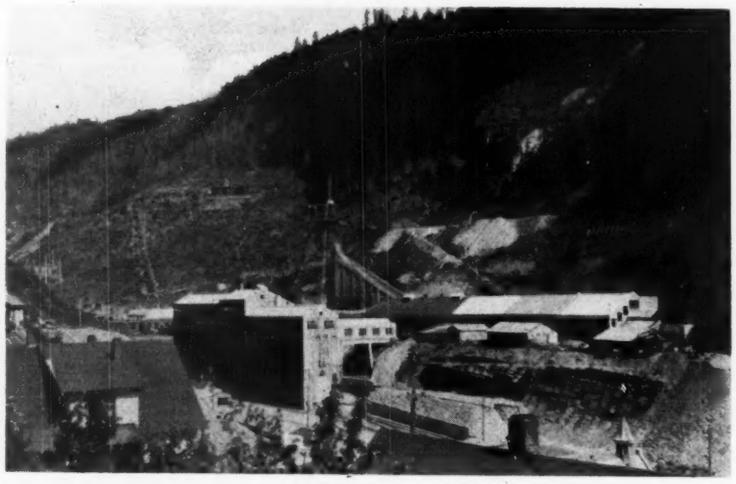
DEVELOPMENT of several mines is being carried on in the Free Coinage district in the Stansbury Mountain range, west of Grantsville, Utah, and about 60 miles west of Salt Lake City. Utah Bunker Hill Mining has acquired the property and assets of the old "L" Marie Mining company, and driving of the main tunnel has been resumed. A compressor is to be installed and the adit advanced in a southerly direction to cut two east-west fissures at their intersection with a north-south contact.

The Falk Mining company, adjoining the old Third Term mine, is advancing its tunnel. Utah Stansbury Apex is also driving an adit. Several other prospects are being worked in North Tempie Canyon.

Bagdad Copper Will Build 3,000-Ton Plant at Hillside

GEORGE THOMAS, general manager of the Bagdad Copper Corporation, has announced that a 3,000-ton mill has been designed for the company, and will be constructed at the property at Hillside, Ariz., during the summer. After three years of research work a metallurgical process has been developed and patented, by the use of which copper is dissolved from concentrates. The process has been tested during the last year in a 50-ton pilot mill. The ore is concentrated by means of flotation. Concentrates are then dried on a waste-heat drier, after which they are calcined in a single-hearth, oil-fired furnace. Between 40 and 60 per cent of the copper in the calcines is said to be soluble in water, and most of the remaining copper can be dissolved in a weak sulphuric acid solution. The dissolving is done in an agitator where the calcines receive a 30-minute treatment in an 0.5 per cent sulphuric acid solution. Copper is removed from the solutions in an electrolytic plant, which has a capacity of 1,500 lb. of copper per day. A small leaching plant is now being built for testing carbonate ores.

The ore reserves of the property are reported as being from 20,000,000 to 30,000,000 tons, averaging 1½ per cent copper. Development work consists of 16,000 ft. of drifts, 40,000 ft. of churn-drill holes, 300 ft. of shaft, 500 ft. of raises, and 200 ft. of winzes.



Surface plant at the Hecla mine, in the Coeur d'Alene district, through which output from the Star mine is handled

Will Increase Star Mine Output to 500 Tons Daily

OPERATIONS at the Star mine of Sullivan Mining, jointly owned by Hecla Mining and Bunker Hill & Sullivan, will be increased to between 450 and 500 tons of zinc ore daily, according to James F. McCarthy, president of Hecla, who is in charge of operations at the Star, which adjoins the Hecla mine, in the Coeur d'Alene district of Idaho. At present the Star property is shipping about 250 tons of ore daily to the old Sweeney mill, at Kellogg, where it is concentrated and then shipped to the new electrolytic zinc plant. Construction of this plant was undertaken as a result of the proving of large tonnages of zinc ore in the Star claims. Installation of a new hoist at the Hecla shaft, through which production from the Star is handled, will greatly facilitate the increase in output.

John Fritz Medal Presented to Herbert Hoover

PRESENTATION of the John Fritz gold medal for 1929 to Herbert Hoover was made at the Executive Mansion, Washington, on April 25, at a luncheon given by Mr. Hoover to present and past members of the board of award, preceding medalists, and presidents and secretaries of the American Societies of Civil, Mining and Metallurgical, Mechanical, and Electrical Engineers. This medal is the highest honor bestowed by these four national engineering societies. It is awarded not oftener than annually for "notable scientific or industrial achievement, without restriction on account of nationality or sex." In accordance with custom, the award to Mr. Hoover was made tentatively and without announcement in October, 1927, and was formally confirmed and announced one year later.

At the presentation Dean Dexter S. Kimball, College of Engineering, Cornell University, chairman of the present board of award, presided and gave a brief history of the medal. Dr. M. I. Pupin, a past president of the American Institute of Electrical Engineers and a member of the board of award, spoke briefly of the human elements of Mr. Hoover's life work.

Dr. John R. Freeman, formerly president of the American Society of Civil Engineers and the American Society of Mechanical Engineers, and a former member of the board of award, spoke of Mr. Hoover's work as an engineer. J. V. W. Reynders, formerly president of the A.I.M.E. and chairman of the board which made the award to Mr. Hoover, presented the medal and quoted from the certificate which accompanied the medal the citation, "To Herbert Hoover, Engineer, Scholar, Organizer of Relief to War-Stricken Peoples, Public Servant." The ceremonies ended with a statement by Mr. Hoover.

Engineering Foundation Asks for Support of Research

A SCIENCE of humanics should be built up by research, declares the annual report of the Engineering Foundation, made public by Alfred D. Flinn, director of the foundation, at 29 West 39th St., New York City. "Experience," says the report, "is showing year after year the actual usefulness and the much greater possibilities of this joint research organization of our four senior national engineering societies, with their 60,000 members. . . . Research interests of engineers are not restricted to so-called material things. Improvement of the facilities for living and communicating lifts life steadily to higher intellectual, moral, and spiritual levels, and promotes health, happiness, and brotherliness. The engineer's studies must include the effects of his technical activities upon his fellow humans and their social organization."

The report tells of the foundation's increased resources, and of its plans to raise further endowment, saying:

"Since 1915, the Engineering Foundation's capital funds have grown from $200,000 to $620,000 and its income from less than $10,000 a year to more than $30,000. This small income has been supplemented by cash, services, materials and facilities. An endowment committee, appointed by the United Engineering Society for the Founder Societies, has for members sixteen prominent engineers, with Colonel E. A. Simmons, member of the American Society of Civil Engineers and the American Society of Mechanical Engineers, as chairman. This committee is seeking $5,000,000 for the Engineering Foundation and $2,000,000 for the Engineering Societies Library by direct gifts of cash or securities, bequests, life insurance, annuities, living trusts, or installment contributions.

"Projects in hand or waiting need substantial funds now; therefore, the foundation especially invites the attention, also, of persons preferring donations for expenditure within a stipulated period, believing that the future will be at least as able as the present to provide for its own needs."

Electrolytic Precipitation Practice at Andes Copper

ONE of the newest copper-leaching and electrolytic-precipitation plants is that of the Andes Copper Mining Company, at Potrerillos, Chile, which has now been in operation less than a year. In next week's issue Carr B. Neel, formerly in charge of the electrolytic department there will describe with a wealth of interesting detail the equipment and arrangement, together with the success and disappointments of the first three months of operation. The firing up of the refining furnace will also be described. This will be the first extended published description of the practice at the new plant.

International Drilling Congress to Meet in Paris

THE second International Drilling Congress will meet in the second half of September in Paris, according to a notice by the Bureau of the First International Drilling Congress. The first duty of the next meeting will be to establish and vote on the statutes of the congress. Another question that will be discussed is the unification of the methods of observation and collection of data obtained through drilling. National committees have been formed by Austria, Belgium, Brazil, Czechoslovakia, Egypt, France, Germany, Hungary, Japan, Mexico, Poland, Rumania, Spain, and the United States.

Psychologists Making Study of Labor Conditions on Rand

A VERY important consideration in mining gold ore on the Rand, where the mines are now the deepest in the world, is the efficiency of the labor force. Therefore, it is interesting to note that Dr. G. H. Miles, assistant director of the National Institute of Industrial Psychology, of London, England, recently arrived at Johannesburg at the invitation of the group of producers comprising Rand Mines. Dr. A. Stephenson will assist him in his labors, and these two scientists are engaged, with Dr. A. J. Orenstein, of Rand Mines, Ltd., in a study that may lead to important conclusions.

The National Institute was founded in 1921 under the presidency of Lord Balfour, with the object of investigating labor in all its aspects, more especially to exploit the possibilities of reducing fatigue. The field included everything from the difficulties of the coal miner to the distractions that beset the waitress. There were many elements which had to be reckoned with in such a research. On the physical side were problems such as illumination and ventilation, on which science had already thrown much light or offered a complete solution; but the human aspects of the problem had also to be considered, such as reaction to environment and to administration.

In a statement made in Johannesburg, Dr. Stephenson has said that the object of the study on the Rand was to get a suitable job for every man. Sometimes a man was found who was too good for the particular job he was doing, and in other cases he was not good enough. Asked whether they were going to concentrate on either white or black labor, Dr. Miles and Dr. Stephenson explained that one could not separate the two. The white man is often in a position of authority over the black, and to that extent the two classes are intimately bound up with each other. The study embraces the whole human problem. Although it is to be confined more especially to the mining industry, its sociological and industrial implications are extensive. It will therefore take some time. Dr. Miles thinks he will remain in Johannesburg for about a month, and Dr. Stephenson may remain for six months.

Inland Steel Makes First Iron-Ore Shipment

The first cargo of iron ore from the Lake Superior district this year was loaded on April 13, at Escanaba, at the head of Lake Michigan, by Inland Steel. This was unloaded at Cleveland, Ohio. On April 15 and 16 the same company loaded two boats at Superior, Wis., for Indiana Harbor. Many boats are now in service, and shipments are being made from all of the ranges. It is generally believed that 60,000,000 tons will go down the Lakes during the 1929 period of navigation.

Mexico City Letter

By W. L. Vail
Special Correspondent

The Return to Normal in the Mexican Mining Districts Gradually Continues

Mexico City, April 17, 1929.—The return to normal operating conditions in the mining districts of the North which were most affected by the military revolution, now in its final phases, continues, with Sonora as the only state in which federal authority is far from complete. In Nuevo Leon, San Luis Potosi, and Chihuahua, smelters and mines are reported to be producing uninterruptedly. In Jalisco and Nayarit rapid movement of troops has alleviated the conditions mentioned in last week's letter and has enabled several properties to resume, notably Cinco Minas, which is now employing about 50 per cent of the usual number of men, and El Favor and Magistral, which are operating at capacity.

OPERATIONS have been discontinued for some time at the Bolanos property, owned by the Bradbury estate, but work will be resumed soon. It is near the Jalisco-Zacatecas border. This territory has been in the hands of the "Christeros," but the government promises to clean it out promptly. Mesquital del Oro has closed, for reasons not made public, and the Amparo group, including Piedra Bola and Mazeta, which closed because of lack of necessary supplies, remain closed, although reports from Guadalajara state that they will probably reopen early in May.

Expectations are that an early meeting of Congress, in extra session, will be called to pass a labor law and to revise the existing mining law or, possibly, to create a new one. In the meanwhile business interests are making strenuous efforts to secure modifications in labor legislation as proposed, and the government is studying the objections.

After several years of idleness, the old Rey de Plata is reported to be about to reopen and construction of a 50-ton mill started. This property is nine hours by trail from Iguala, Guerrero, the nearest shipping point. The ore carries silver, lead, and gold. General Abundio Gomez, Assistant Minister of War, is a large stockholder.

New Storage Building Complete at C. & H. Smelter

At the Calumet & Hecla smelter, at Hubbell, Mich., the new mineral storage building is in commission. It will facilitate the handling of mineral, which will be automatically conveyed to the furnaces. This structure and the installation of a second casting wheel complete the modernization of the smelting plant, which is equipped to take care of all production of Calumet & Hecla and subsidiaries.

Little prospect of a very great increase in Calumet & Hecla production this year exists. Some increase may come through the use of heavier underground electric locomotives and larger tram cars.

W. B. Thompson Endows Arboretum in Southwest

THE Boyce Thompson Southwestern Arboretum at Superior, Ariz., was dedicated on April 6. The arboretum was established and endowed by William Boyce Thompson, prominent mining man. Under the direction of Dr. Franklin J. Crider, the institution conducts studies and experiments with plants, shrubs, and trees of the semi-arid regions of the world in an effort to improve them for economic and ornamental use.

More than 1,000 guests attended the formal opening, at which addresses were made by Dr. Crider, Dr. H. L. Shantz, president of the University of Arizona, and Professor William Trelease, former director of the Missouri Botanical Garden.

Compensation Insurance at California Mines Discussed

ON APRIL 10, R. E. Dillinger, chairman of the Mines and Mining Committee of the California State Assembly, called a meeting at Sacramento to consider California industrial accident mine rates and to determine, if possible, the reason for the excessive rates. At this conference the fact that California has the highest mine rate of any state was admitted. The rate is double the rate obtaining in some coal-producing states, such as Ohio, where the rate for coal mines for each $100 of payroll is $4, whereas the rate in California for metal mines is $9.05. It was also shown that the overloading for insurance rates in California is 40.3 per cent; that $1.80 is collected from the insured companies to pay out only $1 for all compensation costs. The following was admitted: That, during the twelve-year period from 1915 to 1926, inclusive, the insurance companies of California collected for industrial premiums the sum of $148,680,244, but paid out only $80,037,361 for losses, thus leaving a balance of $68,642,882. Moreover, during this period only 52.82 per cent of a premium dollar was expended by insurance carriers for the benefit of injured workmen and their dependents. Again, for the year 1926, over $20,000,000 was collected in premiums in comparison with only $8,000,000 paid in losses.

Another compensation bill is before the legislature, which, if it passes, will increase the mine rates by at least 4 per cent, thus giving a basic rate of about $9.42. The increase in compensation insurance rates for mines is as follows: in 1914, $4.85; 1915, $5.75; 1917, $5.97; 1924, $6.54; 1927, $8.04; 1928, $8.53; and 1929, $9.05.

The small mine operators testified that the compensation insurance rate was so high in California that it will shut them down; that some companies refused to invest in the state on this account. One mine producing 200 tons of ore per day is said to pay $30,000 per year for compensation insurance, or about 50c. per ton of ore milled.

Arizona Magma Electrifying Mines, Near Chloride, Ariz.

ARIZONA MAGMA is electrifying its plant at the Diana mines near Chloride, Ariz. A power line is being built to connect the mine with the main transmission line of the Public Utilities Consolidated Company. An electric hoist, a 750-cu.ft. compressor, and a 250-cu.ft. auxiliary compressor have been installed. A new framing shed has been built, which houses new framing machinery, and a new change house with accommodations for 35 men, a new hoist house, and a new blacksmith shop, equipped with air-operated sharpeners and hammers, have been built. The old headframe has been remodeled and equipped with an automatic dump. The shaft has been retimbered to a depth of 350 ft., and a contract will be let to sink it to the 550 level. H. S. Carpenter is superintendent.

Magma Apex to Develop Claims in Superior District

Magma Apex Mining is preparing to develop a group of 54 claims at Superior, Ariz. The east boundary of the group is 400 ft. from the No. 5 shaft of the Magma Copper Company. Magma Apex is reported to have sold enough stock to finance the sinking of a 3,000-ft. shaft and to do 6,000 ft. of diamond drilling. O. H. Anderson, Tennessee banker, is the organizer of the company, which is a reorganization of the old Sam Thorpe Mining Company.

Acquire Complete Control of Cripple Creek Mine

New El Paso Mines, Inc., has purchased the minority holdings in the El Paso mine, in the Cripple Creek district of Colorado, which it has been operating for some time. The property consists of 73½ acres, and has been held in fee by Beacon Mining & Milling, a Denver company. This organization will probably liquidate now that the sale has been completed. Last summer, a surface strike which aroused considerable local interest was made on the property by leasers.

MARKET AND FINANCIAL NEWS

Status of the Copper-Refinery Capacity Question—An Editorial Summary

THE subject of copper-refinery capacity has been much in the limelight during the recent hectic copper-market activity. The statement—without apparent basis in fact—that "refineries were the neck of the 'copper' bottle" was first heard in October, 1928. Though the statement had no responsible backer, it was rapidly circularized and became almost a slogan for those attempting to explain the copper-market situation, and particularly those who sought excuses for predicting excessive and long-continued bullishness in the copper situation. To sponsors of the copper "tipster" sheets in particular this precept became a doctrine. Several authoritative statements have appeared, minimizing the possibility of a shortage in copper-refining capacity, but nevertheless the belief continues to exist in certain quarters that the limitations of copper-refining capacity are controlling the output of copper. This understanding has been encouraged through recent editorial declarations by responsible—if not authoritative—publications, purporting to explain away all the recent manifestations of a troubled copper market by the statement that copper-refinery capacity is inadequate. An examination of the facts reveals the actual situation to be considerably different from the condition indicated by these rumors.

In the accompanying table, the four columns are briefly explained by title. Under Column (A) is shown production for 1928. The total and most of the figures showing output by plants in this column are matters of record, though in a few instances the distribution is conjectural. In Column (B) the annual capacity of the various plants as published in the year book of the American Bureau of Metal Statistics is shown. Where such capacity figures are not available, the production in 1928 is taken as a nominal statement of capacity. The figure for the Potrerillos plant of Andes Copper is calculated from data contained in the circular of information concerning this company's operations, made public several years ago at the time negotiations for the proposed $40,000,000 debenture-bond flotation were under way. To make this column properly conservative, the Inspiration and Ajo capacity figures are assumed to be included in the stated capacity of Anaconda's Raritan refinery, inasmuch as cathodes from these southwestern plants are melted and cast into shapes at Raritan. Column (C) represents annual production for 1929 projected at the rate recorded during the first quarter of the year. The total for this column and several of the plant outputs are directly ascertainable from published statistics, but the distribution in detail is more a matter of conjecture than was true of the figures under (A). An assumption made here is that a considerable tonnage of blister copper of low precious-metal content from the Hayden smelter has been sold direct by the Kennecott interests to fulfill Braden copper contracts, this procedure being occasioned by the recent forced curtailment of operations at Sewell and Caletones. Undoubtedly, this assumption is correct in principle, but the tonnage estimate is purely arbitrary. Under Column (D) is shown *Engineering and Mining Journal's* estimate of copper-refining equipped capacity in 1929. Certain assumptions have been made as to refinery operating flexibilities in general, but for the greater part the plant capacities shown in this column have been ascertained by direct communication with the companies concerned or from information that is freely available to the profession. For example, that cathode capacity of the Baltimore refinery has been considerably increased recently by a new spacing arrangement of cathodes and anodes in the electrolytic cells is generally known.

A significant point to consider in comparing Columns (B) and (D) is the fact that the nominal or "official" capacities stated in (B) were doubtless prepared by plant managers in times of normal productive operation. Theoretical plant capacity may be merely a matter of calculation, but that level-headed engineers are unlikely to place an estimate on the capacity of their plants other than one well below the theoretical maximum seems certain. In most instances plant capacity is a purely hypothetical question anyhow, and a question that is properly answered only by trial. Then, too, if economic conditions warrant, capacity may be increased to an appreciable extent by stepping up current density; this factor, however, has been given little weight in these considerations.

Another possibility that deserves consideration here is that of considerable use of rough, or blister, copper without additional refining. A not insignificant tonnage of copper finds its way into consumption in this form under normal conditions, and the assumed use of Hayden blister, as mentioned in the foregoing, is indicative of possibilities of a trend that might take place in this direction should demand for copper become sufficiently urgent.

In summing up this array of statistical evidence, then, it appears that actual refinery output in 1928 was about 18 per cent less than the "nominal" capacity of refineries and about 33 per cent under 1929 "available" capacity. Like-

Statistics of North and South American Copper Refineries

(In Short Tons, Annually)

	(A) 1928 Production. Distribution in Part Conjectural.	(B) 1928 Capacity. Officially Stated.	(C) First Quarter 1929 Production Rate. Distribution in Part Conjectural.	(D) 1929 Capacity Available. *E. & M. J.* Estimate.
Electrolytic Refineries				
Baltimore (ASR)	350,000	360,000	380,000	400,000
Raritan (ACM)	195,000	270,000	240,000	270,000
Laurel Hill (NC)	155,000	250,000	180,000	250,000
Chrome (AM)	197,000	204,000	220,000	240,000
Chuquicamata (CC)	135,000	180,000	185,000	200,000
Great Falls (ACM)	131,000	162,000	162,000	165,000
Perth Amboy (ASR)	120,000	120,000	134,000	138,000
Tacoma (ASR)	90,000	102,000	100,000	114,000
Potrerillos (ACM)	10,000	38,000	37,000	45,000
Trail (CMS)	9,000	25,000	.....	25,000
Inspiration (ICC)	25,000	(a)	25,000	25,000
Ajo (C & A)	10,000	(a)	10,000	10,000
Total electrolytic	1,427,000	1,711,000	1,673,000	1,882,000
Furnace Refineries				
Caletones (BCC)	110,000	110,000(b)	98,000	120,000
Hubbell (C & H)	61,000	61,000(b)	62,000	108,000
Coles Creek (MSW)	29,000	29,000(b)	29,000	38,000
Hancock (QMC)	.....	.....	.....	15,000
Hayden (ASR) (c)	.....	.....	8,000	16,000
Total furnace	200,000	200,000	197,000	291,000
Total	1,627,000	1,911,000	1,870,000	2,173,000

(a) Included under Raritan. (b) Production for 1928. (c) All figures for this plant entirely conjectural.

wise, and of particular significance, is the fact that the record-breaking production recorded during the first quarter of 1929 fails to occupy the 1928 officially stated annual capacity of refineries by about 40,000 tons, and falls short by some 16 per cent, or approximately 300,000 tons, of taxing the 1929 estimate of available capacity. A study of these statistics certainly leaves little basis for argument that refining capacity is "the neck of the bottle" so far as copper production is concerned.

In all fairness to both sides of the question it must be pointed out that several items in Column (D), available refinery capacity, do not represent "effective" capacity. An item of this nature is the 25,000 tons credited to the Trail refinery, which has not produced since the Rossland mines' output sloughed off and Granby transferred the refinery-destination point of its Allenby copper to Tacoma. Likewise, a good 50,000 tons should be deducted from the "available" figure for the three Michigan furnace refineries in order to get "effective" capacity which is controlled by mine and tailing plant production. Deducting this 75,000 tons from the estimate of "available" capacity leaves about 2,100,000 tons as "effective" capacity, which exceeds twelve times the record monthly output of 163,000 tons recorded in March, 1929, by 140,000 tons, or nearly 8 per cent. Before 1930 arrives, the equivalent of a further increase in North and South American refinery capacity will have been effected by the completion of the final units of the Oolen refinery, in Belgium, which will then be able to refine all the Union Minière copper, part of which is now refined here, thereby releasing additional capacity for American production. Looking ahead a bit further, an additional 100,000 tons of refining capacity will become available in the first half of 1930 with the completion of the Nichols-Phelps Dodge plant at El Paso. In closing, the observation is warranted that considerably more copper ore will have to be mined than is being moved at present before refineries can be accused broadly of damming up the flow of copper into consumption.

—◆—

NATIONAL METAL EXCHANGE recently announced a set of rules to govern its copper trading activities. The rules, in the form of amendments to the by-laws of the exchange, have been approved by the board of governors and will be submitted to the members for a vote on April 29. Trading in copper futures will begin on the exchange about the middle of May.

MOHAWK MINING COMPANY directors have decided that $805,000, the amount remaining unpaid on the outstanding stock and subject to call, shall be transferred from surplus to capital stock account. By reason of this action the 115,000 shares of stock now outstanding have been rendered fully paid and non-assessable shares and are subject to no further call or assessment.

Higher Copper Price Boosts Phelps Dodge Earnings $6,450,000 in 1928

PHELPS DODGE Corporation reports net profit, after depreciation but before depletion, of $10,077,451 in 1928, compared with $3,623,582 in 1927. The increase in earnings is directly attributable to the improvement in the price of copper and to a somewhat greater production. Consolidated income account for 1928 compares with the records for 1927 and 1926 as follows:

	1928	1927	1926
Gross income..	$47,230,068	$32,985,490	$38,424,038
Expenses.....	34,764,539	27,455,027	31,175,849
Depreciation...	2,388,077	1,906,881	2,378,523
Profit.....	$10,077,451	$3,623,582	$4,869,666
Depletion.....	6,395,765	4,822,680	5,817,264
Net loss.....	(a) 3,681,686	$1,199,098	$947,598
Dividends.....	4,000,000	3,000,000	2,750,000
Deficit.....	$318,314	$4,199,098	$3,697,598
Contingent reserve.....	2,952,868	1,350,000	.....
Previous surplus.....	68,538,156	74,087,254	77,784,852
Profit-and-loss surplus	$68,219,842	$68,538,156	$74,087,254

(a) Profit.

President Walter Douglas in his remarks accompanying the annual report states that no new ore of importance was developed in either the limestone or porphyry sections of the Copper Queen Branch, and the ore reserves were not maintained. A program of intensive development of the limestones in the main productive area, not already explored, has been authorized and will be carried out as rapidly as practicable during the next two years. The major development in the new Warren shaft district was actively undertaken, and certain ore indications were encountered which may give a lead for future exploration both vertically and laterally. At Sacramento Hill, steam-shovel operations have reached a depth on the orebody that makes it desirable to mine the ore in future from underground. Extraction drifts have therefore been extended from the Sacramento shaft, to which the ore will be trammed and hoisted at less cost than continuing with shovels. These drifts also will serve for the mining of other adjacent porphyry orebodies on which mining as yet has not begun. During the year, owing to the increased amount of water available from the Warren shaft development, an addition to the precipitating plant was constructed and a larger area of the low-grade ore dumps was irrigated. This extension of operations has increased the copper output from this source to more than 1,000,000 lb. per month at a very low cost.

There has been constant improvement in concentration practice, and the new reverberatory plant at the Douglas smelter has met and exceeded estimates both as to tonnage and fuel consumption and has served materially to reduce the cost of smelting. The lead smelting unit operated throughout the year on a reduced tonnage, as the prevailing price of the metal made it undesirable to continue concentrating low-grade ores from the Bisbee mines and diminished the tonnage of custom ores from outside sources. At the Morenci branch, as the increased hardness of the ores and percentage of soluble copper therein has further curtailed the production, it has been decided to increase the capacity of the concentrator from 4,000 to 5,000 tons per day, and this work is now in progress.

Because of the very satisfactory extraction results obtained in the experimental leaching plant at Burro Mountain, the equipment has been transferred to the Douglas smelter and re-erected there on a more elaborate scale, and it will be utilized to experiment on the different types of Morenci ore, with a view to determining whether the ore would be more amenable to leaching than to concentrating. Indications are that in view of the high acid-soluble content of the ore, a much better extraction of the copper can be attained through the former methods. In the large low-grade orebodies adjacent to the present mining operations an intensive program of exploration is in progress to determine not only the grade and tonnage of the ore but its vertical and lateral boundaries, so that within the next two years sufficient data may be available on which to base both methods of mining and daily tonnage of ore for which beneficiating facilities should be provided.

In Mexico, operations have continued normally and satisfactorily, with an increased production and a maintenance of the ore reserves. Though operating conditions are far from ideal, and taxation is heavy, both the federal and state governments have been most considerate and have endeavored to meet the company's desires wherever consistent. Until there is some definite assurance that the demand for copper would justify the reopening and equipping of the Burro Mountain branch, it has been decided from the point of view of economy to close down this property entirely. All development has therefore been suspended and an agent has been put in charge of the plant and mines.

Phelps Dodge Production Data

Company Ores:	1928	1927
Copper, lb.....	204,273,993	184,858,377
Lead, lb.....	4,358,321	2,241,256
Silver, oz.....	1,370,494	1,226,223
Gold, oz.....	41,301	37,160
Manganese, lb.....	3,049,450	3,228,162
Custom ores:		
Copper, lb.....	3,676,247	3,926,320
Lead, lb.....	10,330,241	3,322,533
Silver, oz.....	3,292,666	619,413
Gold, oz.....	17,188	6,258

—◆—

TEXAS GULF SULPHUR COMPANY for the three months ended March 31, 1929, reports net earnings of $3,880,260. During these three months the company decreased its depreciation and federal tax reserve by $157,193, making the total $11,502,006 on March 31, 1929.

Consol. M. & S. Earnings Declined in 1928 Despite Increased Production

NET PROFIT of the Consolidated Mining & Smelting Company declined from $13,139,957 in 1927 to $10,341,162 in 1928. Lower prices for lead and zinc are largely responsible for the decline in earnings, as the company's throughput of 1,665,586 tons of ore in 1928 was of approximately the same average grade as the 1,405,872 tons treated in 1927.

Profit-and-Loss Account for the Year Ended Dec. 31, 1928

Credit

Sales of smelter products and ore	$29,296,520
Ores, metals, and smelter product on hand and in transit at Dec. 31, 1928	5,130,329
Revenue from investments and sundry advances	819,563
Rents, royalties, and sundry revenue	46,898
	$35,293,311

Debit

Ores, metals, and smelter product on hand and in transit at Dec. 31, 1927	$4,309,160
Customs ore and bullion purchased	3,698,691
Freight and insurance on ores from company's mines	913,064
Mining, smelting, and general expense	12,893,719
Development expense	597,943
Depreciation of plant and equipment	1,745,948
Provision for depletion of mineral properties	650,799
Interest, bank and general	23,536
Directors' fees	6,340
Fire insurance reserve	97,188
Employees' pension fund	14,578
Sundry items written off	1,178
Balance, profit before provision for dominion and provincial income taxes	10,341,162
	$35,293,311

President James J. Warren states that, excepting the Rossland properties, the company's mines are developing satisfactorily. Though the extraction of ore is heavy, the reserves are well maintained and are sufficient for many years of profitable operations. Many properties were optioned during the year, and a great deal of exploratory work was done on them, the company's policy being to undertake the development of any promising mineral properties which can be secured on reasonable terms in any accessible part of Canada.

With the completion of the first unit of the contact sulphuric acid plant, production of acid phosphate on a commercial scale can begin and can gradually expand as the market develops. Consideration has been given to the production of ammonia, which, combined with sulphuric acid, makes ammonia sulphate a well-known fertilizer, much used in the Orient and elsewhere. It can be combined, too, with phosphate rock and sulphuric acid, making a fertilizer carrying both nitrogen and phosphorus, for which there is a good market. It is likely, therefore, that in the near future the company will be a large producer of synthetic fertilizers. In addition to the commercial aspects, this should eliminate largely, if not entirely, any real damage from sulphur dioxide.

For some time the directors have had under consideration the construction of a copper refinery and a zinc reduction works to treat the blister copper and zinc concentrates produced in eastern Canada. Recently an arrangement has been made with Ventures, Ltd. (representing the Lindsley group), which controls large qualities of blister copper and zinc concentrates. Plans are therefore under way for the construction of the necessary plants. A separate company or companies may be formed. It is possible, too, that others than Ventures, Ltd., may be associated with Consol. M. & S. in the enterprise.

Similarly, the directors have been considering the erection of a copper smelter and refinery on the Pacific Coast. They are prepared to proceed with this as soon as sufficient ore and blister copper are available to warrant the large expenditure involved. Development of copper properties tributary to Pacific tidewater will ultimately provide sufficient material. Possibly it will be necessary to wait until contracts between the present large copper producers on the British Columbia coast and United States smelters, for the treatment of their products, have expired.

Capital expenditure amounting to $3,695,614 was made, of which the more important items were as follows:

Property:	
Purchased of shares of West Kootenay Power & Light Company, Ltd.	$1,500,000
Advances to Coast Copper Company.	198,125
Advances to Buena Vista Company (This company owns the Big Missouri group)	167,907
Advances to the Solar Development Company (This company operates mostly in the United States)	61,501
Plant:	
Hunter V. mine equipment	10,710
Sullivan mine and mill additions	278,677
St. Eugene mill	25,162
Smelter extensions	1,001,029

Of the property expenditure, all of the foregoing specified amounts were added to capital assets. The remainder of the property expenditure and all of the plant expenditure were charged to operating revenue and added to "Additions to property through profit and loss."

Consolidated Mining & Smelting Company Production Data

Production	1928	1927
Ore, tons	1,665,586	1,405,872
Gold, oz.	23,623	29,490
Silver, oz.	7,673,762	7,179,607
Lead, lb.	318,831,578	291,043,120
Copper, lb.	17,806,306	18,522,742
Zinc, lb.	163,530,890	147,054,623

Production of cadmium metal started during the year, and a ready market was found for the product at satisfactory prices, according to the sales manager's report.

MAGMA COPPER COMPANY produced during the three months ended March 31, 1929, 9,722,101 lb. of refined copper at a cost of 9.24c. per pound, after deducting credit for gold and silver. This cost does not include any allowance for federal taxes, but includes depreciation and all other fixed and general expenses. Net earnings for the same period before deducting federal taxes were $992,037, based on a net sales price of 19.444c. per pound of copper.

Patiño Earnings Rise Despite Tin Price Drop

NET PROFIT of Patiño Mines & Enterprises Consolidated increased from $4,800,071 after depreciation and depletion in 1927 to $5,224,226 in 1928. This improvement in the company's earnings comes in the face of a considerable reduction in the price of tin and is attributable to increased production and lower operating costs.

Income From Mine Operations	1928	1927
Sales	$8,912,239	$9,227,372
Interest	160,976	119,012
Exchange	1,004	50,133
Sundries	188,032	85,709
Inventory tin concentrates	9,104,655	6,332,864
Total	$18,366,998	$15,815,091
Total all costs	11,024,651	8,840,406
Profit from mines before depreciation	$7,342,347	$6,974,685
Add profit from railroad	449,835	396,311
Total	$7,792,182	$7,370,996
Less interest accrued purchase railroad	79,890	143,455
Balance	$7,712,291	$7,227,541
Less provision for Bolivian profit tax	574,417	562,660
	$7,137,873	$6,664,880
Less depreciation and depletion reserves	1,913,647	1,864,809
Net profit	$5,224,226	$4,800,071

Ore developed during the year contained 29,132 metric tons of fine tin, which is 13,116 tons in excess of the tin extracted from the ore reserves and 5,287 tons more than that from all other sources. Ore reserves at Dec. 31, 1928, contained 71,426 metric tons of fine tin. The company has entered into negotiations to secure the tin-smelting plant of Williams, Harvey & Company at Bootle, England.

NEW QUINCY MINING COMPANY has declared a dividend of 10c. a share, payable May 27, 1929, to stock of record May 15. This dividend, amounting to $140,000, is the company's first disbursement. Production is averaging 125 tons daily. New Quincy is the latest Utah property to emerge from the assessment class to the ranks of dividend payers. A prospect for almost 30 years, some of the stockholders have paid twenty assessments. By May 15, Manager A. L. Hurley expects to have the mine producing 225 tons daily. Thomas H. Sutton has been elected a director to succeed the late George Morgan.

CALUMET & ARIZONA MINING COMPANY-NEW CORNELIA COPPER COMPANY consolidation was formally approved at the annual meeting of the former company which was held in Bisbee April 15. At the meeting the directors voted to spend $178,000 for a new copper-casting plant at the Douglas smelter; $150,000 for improvements and deepening the Campbell shaft to 3,500 ft.; and $25,000 for a new electric high-pressure compressor for the Junction shaft in Lowell. All the directors then holding office were re-elected and all of the former officers, headed by Gordon R. Campbell as president, were re-elected by the board of directors.

Calumet & Hecla's Profit Up 430 per Cent

NET PROFIT of Calumet & Hecla Consolidated Copper Company amounted to $3,110,573 in 1928, compared with $582,745 in 1927, a net advance of approximately 430 per cent. During the year a total of 91,308,000 lb. of copper was produced from the company's mines, at an average cost sold, but not including depreciation or depletion, of 10.1c. per pound, comparing with mine production of 80,043,000 lb., at an average cost of 10.45c. per pound, in 1927. Production from the company's reclamation plants totaled 29,896,000 lb., at an average cost of 5.95c. per pound in 1928, as against production of 28,717,000 lb., at 6.63c. per pound, in 1927. Ore mined during the year was of slightly lower grade than that mined during 1927.

Operations were uninterrupted at the Lake Linden and Tamarack reclamation or tailings re-treatment plants. Results, both economically and metallurgically, were the best ever attained. The Hecla sand tailings bank, as well as the Tamarack tailings bank, contain considerable tonnage of amygdaloid material, the copper of which was never figured as of commercial grade, but some of which may be treated at a slight profit at present prices of copper. The combined results for the year and to date follow:

	1928	Since Starting
Tons treated	2,629,000	20,779,000
Assay headings, per cent	0.666	0.669
Assay tailings, per cent	0.094	0.146
Pounds refined copper	29,896,000	217,288,000
Pounds refined copper per ton treated	11.37	10.46

During the year the company's smelter received 103,600 tons of concentrates and massive copper, and smelted 102,939 tons, producing 121,527,000 lb. of refined copper. The new melting furnace was completed in June and went into operation in August, melting an average of 250 tons of charge daily.

Earnings Statement

Receipts

Copper sales	$20,036,879	
Dividends	39,618	
Interest	238,918	
Miscellaneous	30,445	
		$20,345,861

Disbursements

Copper on hand Jan. 1, 1928	$3,650,171	
Production	9,662,270	
Selling, administration, federal and state taxes	1,659,985	
Miscellaneous	189,124	
	$15,161,551	
Less copper on hand Dec. 31, 1928	2,115,276	13,046,275
Operating profit		$7,299,586
Depreciation	$1,738,754	
Depletion	2,450,257	4,189,012
Net profit carried to surplus		$3,110,573

American Zinc, L. & S. Earned $861,157 in 1928

PROFIT of the American Zinc, Lead & Smelting Company in 1928 totaled $861,157, before deducting for depletion or depreciation. Although the earnings of the year, after depreciation and depletion charges, were sufficient to cover the regular dividend on the preferred stock, these earnings were utilized for capital expenditure, so that the company's floating indebtedness was no greater at the end of the year than it had been at the beginning.

Financial Statement for 1928

Profit from operations		$908,467
Interest on loans		47,310
Profit		$861,157
Earned surplus at Dec. 31, 1927	$1,705,081	
Surplus adjustment	15,274	1,720,356
		$2,581,514
Deduct:		
Transferred to depletion and depreciation reserves	$379,686	
Adjustment of investment in own preferred stock	644,578	
Special reserve for loss on Silver Dyke investment	518,885	1,543,150
Earned surplus at Dec. 31, 1928		$1,038,363

W. A. Ogg, president of the company, in his remarks accompanying the annual report states that the company's smelting margin for 1928 averaged a little below that of 1927. Modernizing of the East St. Louis plant was completed in the last quarter of 1928. Operating and metallurgical efficiency in both mining and smelting departments was considerably improved during the past year.

Operations of the Silver Dyke Mining Company resulted in a mining profit of $41,624 in 1928. The conditions encountered at this property from the outset were so different from what had been anticipated, and the metallurgical problems proved so difficult, that several years were required for working out the best solutions, during which time a large part of the ore reserves was extracted. The extent of the unextracted ore at the end of the year is known, and it will probably all be mined out sometime during 1929.

Exploratory work upon the Jarnagin group of properties, located about 16 miles east of Mascot, Tenn., resulted in the development of a sufficient amount of ore to warrant the sinking of a shaft and developing the ground for the extraction of ore, which will be transported by rail to Mascot, where it will be milled along with the ore from the company's Mascot mine.

To enable the company to furnish grades of limestone it could dispose of but was not in a position to produce, a well-equipped quarry at Strawberry Plains, Tenn., near Mascot, was leased for twenty years from the Holston Quarry Company.

Capital expenditures for 1928 cover the modernization of the East St. Louis smelter, improvements at the Columbus (Ohio) plant, and development and construction work at the Mascot and Jarnagin mining properties in western Tennessee.

London Financial News

BY W. A. DOMAN
Special London Correspondent

LONDON, April 9, 1929 — Rhodesian copper shares have again had the light turned upon them, and some good buying has taken place, particularly of N'Changa and Roan Antelope. How true it may be I know not, but a rumor is current that one of the South African finance houses has made a bid for the control of the Rhodesia Katanga Company, which owns the Kansanshi mine. Sir Robert Williams is credited with the intention of retaining the control, which he now has, but intentions and decisions may sometimes be influenced by cash. The Northern Rhodesia copper output is not likely to be important for a few years yet.

The Kansanshi has undergone some remarkable developments, and an interesting position is looked for.

Tin has fallen from its high estate to £208 16s. 3d., though this figure worries no one who is thoroughly interested in the position. Alfred James has made a special study of tin, and, as he says, he goes over everything with a slide rule and compares results with the remarkable statistics he has gathered over a long period of years; and he sees no need for anxiety in the position at all. It is the speculator who goes wrong. He wants to get rich quickly. Alfred James suggests that in two years' time we shall see something special in tin and tin prices. As he has proved a correct prophet on former occasions and in connection with other metals, he certainly has a following here in connection with tin.

Since its capital rearrangement some years ago, the Union Corporation has not looked back. Its interests are varied and almost world-wide. For the last calendar year, which is also the company's financial year, there was a realized net profit of £428,582, this comparing with £386,160 for 1927. The total dividend per share for the year is 5s. 6d., against 5s., and the company carries forward £116,595, or £13,500 more than brought into the account. The Union Corporation is regarded as one of the strongest of the finance undertakings.

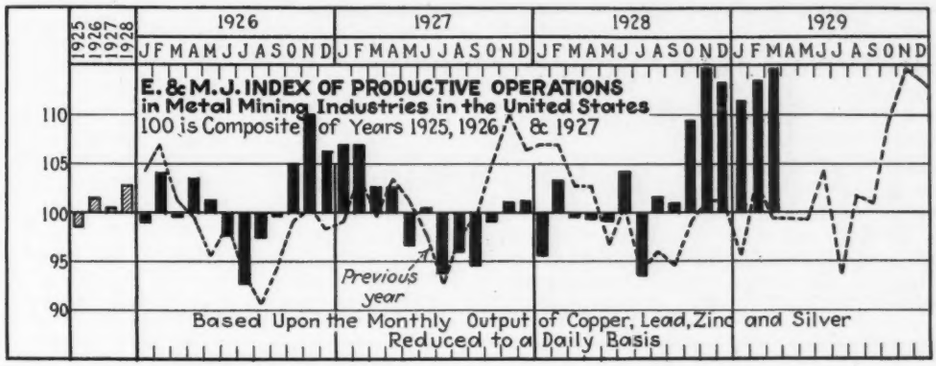
—◆—

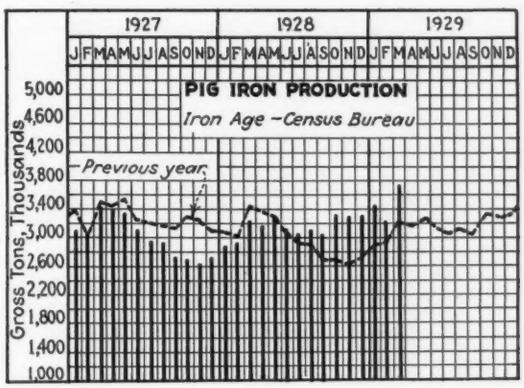
ANACONDA COPPER COMPANY has warned holders of its fifteen-year 7 per cent convertible debenture bonds that they will lose their right to subscribe to new stock of the company if they fail to exercise their conversion privilege on or before April 30. Debentures which are delivered to the trustee, the National City Bank, on or before that date for conversion, will be accepted and considered as having been converted as of that date and stock issued will be entitled to subscription rights.

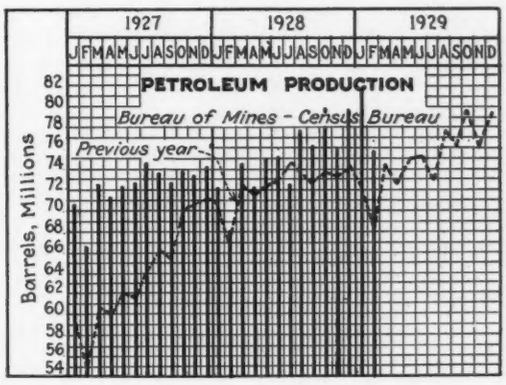
Similarly, stockholders of the Chile Copper Company are warned that if they fail to tender their stock in exchange for Anaconda shares on or before April 30 they will forfeit the right to subscribe to the new Anaconda shares. The offer to exchange Chile Copper stock for Anaconda stock terminates on that date. The basis of the proposed exchange is 73 shares of Anaconda stock for 100 shares of Chile.

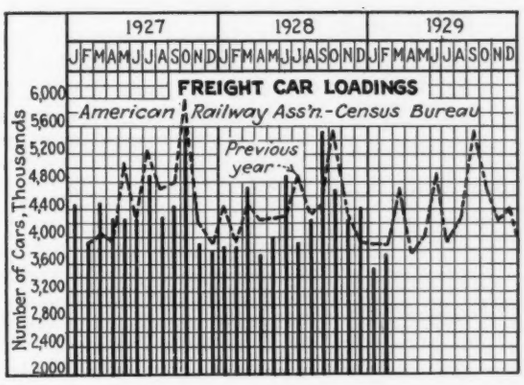
Indicators of Industrial Activity

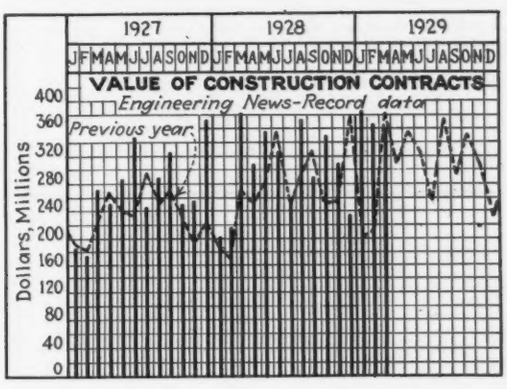
of Significance to Mining

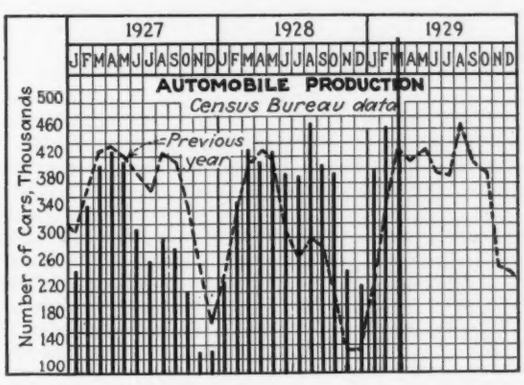

1925
1926
1927
1928
1926
1927
1928
1929
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
E. & M.J. INDEX OF PRODUCTIVE OPERATIONS
in Metal Mining Industries in the United States
100 is Composite of Years 1925, 1926 & 1927
110
105
100
95
90
Previous year
Based Upon the Monthly Output of Copper, Lead, Zinc and Silver
Reduced to a Daily Basis

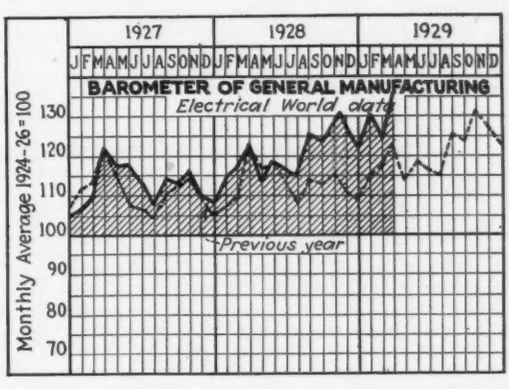












The Market Report

Dullness Continues to Feature Metal Markets

New York, April 24, 1929—Inactivity and the absence of consuming demand featured the major non-ferrous metal markets during the last week. In this respect the situation is but little changed from that existing in the period immediately preceding.

Copper Steady at 18c.

Though sales of copper have not been large, the tonnage has been fairly well distributed over each day of the week and among the three custom smelters. Consequently, the market may be described as steady if not firm. Whether a period of price stability is to be experienced in the immediate future appears to depend largely on the attitude of foreign buyers. Custom smelters are fairly comfortably fixed as to their immediate position, and with primary producers maintaining a policy of "hands off" in the domestic market, the future trend of prices must depend largely on the extent of the foreign demand, for, though producers as a group may be considered well sold into July in the domestic market, they are not similarly sold in the export market, and a continued absence of demand from abroad certainly will weaken the copper market situation. Sales by Copper Exporters, Inc., during the past week have been about two-thirds of the total reported so far this month, but even so the total is virtually negligible. The export price remains at 18.30c. per pound, c.i.f. usual European destinations.

Most of the tonnage sold during the past week has been in relatively small lots, and delivery dates specified have been fairly well distributed between April and August and in intervening months. No tendency to defer shipments from refineries is reported, and consequently it appears probable that April statistics will reveal a continuation of the high rate of deliveries, with little chance for any accumulation of stocks at refineries. Fabricators report a small amount of new business coming in from day to day, but there is little question that the recent action of the Federal Reserve Board in disturbing the credit situation has had a decidedly upsetting effect on business conditions in a number of industries.

Daily Prices of Metals

April	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
18	17.775	45.25	7.00	6.85	6 625
19	17.775	45.50@44.125	7.00	6.80@6.85	6.625
20	17.775	43.75	7.00	6.80@6.85	6.625
22	17.775	44.50	7.00	6.80@6.85	6.625
23	17.775	44.75	7.00	6 80@6.85	6.625
24	17.775	44.875	7.00	6.80@6.85	6.625
	17.775	44.656	7.00	6.829	6.625

Average prices for calendar week ending April 20, 1929, are: Copper, 17.775; Straits tin, 45.031; N. Y. lead, 7.000; St. Louis lead, 6.842; zinc, 6.613; and silver, 55.708.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
18	79¼	77	84	204¼	205¼	24⅜	24¼	26⅞	26 11/16
19	77¼	74½	83	199¾	200¼	24 13/16	24¼	26 11/16	26½
22	77½	74½	83	198¼	200¼	24⅞	24 5/16	26 11/16	26½
23	77¾	74⅜	83¾	202¼	204¼	24⅜	24 9/16	26 9/16	26 7/16
24	77½	74⅝	84	203⅜	205¼	24 11/16	24⅛	26 9/16	26 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
18	4.84⅞	55¾	25 13/16	84s10¼d	22	4.84¾	55½	25 11/16	84s11½d
19	4.84⅞	55⅝	25 13/16	84s10½d	23	4.84⅞	55½	25 13/16	84s10½d
20	4.84¾	55½	25¾	.....	24	4.84 13/16	55⅝	25¾	84s10½d

Average: Silver, 55.625c.; Sterling Exchange, 484.823c.

New York quotations are as reported by Handy & Hartman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Lead Continues Quiet

No particular trend, either up or down, is apparent in the lead market. A moderately larger tonnage of lead was sold in the week ending today than for the week before, but the market cannot yet be characterized as active, or even up to normal. The price in the East is unchanged, at a basis of 7c., New York, which continues to be the contract price of the American Smelting & Refining Company. In the Middle West, where the lion's share of the business has been done, slight concessions in price were made by some sellers, so that the market for the last few days must be quoted at a range of 6.80@6.85c., compared with the 6.85c. level of a week ago. In fact, some resale lead was sold on Monday as low as 6¾c. Most of the business was for prompt delivery, but in the last day or two several lots for May and June have been booked. No June lead is available for less than 6.85c., St. Louis. Corroders and cable manufacturers have been in the market, with some demand for carloads from miscellaneous purchasers. Though battery manufacturers are doing an active business, they have not been factors in the open lead market recently.

Zinc Continues Featureless

Sales of Prime Western zinc during

the week ending today have been virtually non-existent. The few sales reported have varied so broadly in price that no attempt has been made to show a day-by-day quotation based on actual conditions on each day; rather, the weighted average of all sales for the week has been determined, and that price is shown throughout the period under review. Most of the producers continue to hold at 6.80c., and some sales have been made at that price; other sellers are offering at 6.60c. per pound, and reports of at least one sale at 6.55c. per pound have been heard.

Tin at New Low

When Straits tin dropped to 43¾c. on Saturday, a new low for the current movement, and the lowest price since 1924, was registered. Buying was fairly good at the concessions, and also a good business was done on Monday, when the price went back up above 44c. Yesterday and today have been very quiet, however. The slight improvement in quotations the last three days has been influenced by support of the market by the Anglo-Oriental group in London. Prompt and forward tin are selling for the same price.

Silver Lower and Quiet

The tendency of silver during the last week has been downward, and the markets of the world have been quiet. China has operated both ways, and occasional orders have been received from India. The closing is uncertain.

Mexican Dollars (old Mexican pesos): April 18th, 42c.; 19th, 41⅞c.; 20th and 22d, 41¾c.; 23d, 42c.; 24th, 41⅞c.

Foreign Exchange

Closing cable quotations on Tuesday, April 23, were as follows: Francs, 3.90⅞c.; lire, 5.23¾c.; and marks, 23.71c. Canadian dollars, ¾ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 9⅜@9½c. per lb. for all positions. Cookson's "C" grade, spot, 14¾c.

BISMUTH—Per lb., New York, in ton lots. $1.70. Smaller lots. $1.85 and up.

CADMIUM — Per lb., New York: 85@95c. Active demand.

IRIDIUM—Per oz., $260@$265 for 98 @99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $122 cash. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of April 6.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15@$15.50; Western scheelite, $15.50. Nominal.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the April 6 issue.

Rain Retards Tri-State Output

Joplin, Mo., April 20, 1929

Blende		Per Ton
High		$45.40
Premium blende, basis 60 per cent zinc	$44.00@	45.00
Prime western, basis 60 per cent zinc	43.00@	44.00
Table concentrates, 60 per cent zinc	41.00@	43.00
Flotation concentrates, 60 per cent zinc	38.00@	40.00
Average settling price all zinc		42.69
Galena		
High		$98.75
Basis 80 per cent lead		90.00
Average settling price, all lead		97.02

Shipments for the week: Blende, 15,271; lead, 4,288 tons. Value, all concentrates the week, $1,067,890.

This valuation marks the first return to a weekly million-dollar figure since Aug. 27, 1927, a weekly valuation attained only twice in 1927, but which was common in 1926.

Although purchases of zinc concentrates dropped last week and this week, from the tonnage of several previous weeks, enough had been purchased ahead to hold this week's shipment up to an average, and a little above the production, estimated around 15,000 tons, which was produced from 136 mills now active.

Unusually heavy rains are having a tendency to reduce production by increasing the flow of water underground. Rainfall in the last 24 hours totaled 3 in., and was accompanied by a strong wind. Last night one mill was put out of commission and several others were slightly damaged. An increased inflow of water may be expected, with further hindrance to operations. The week's record of rainfall approximates five inches.

Last week's large shipment of lead was almost doubled this week, and another large shipment is expected to follow next week. The concentrate from reserve stocks, it is reported, was all contracted on the $100 basis, prior to the decline in price last week.

Platteville, Wis., April 20, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 750 tons; lead, 80 tons. Shipments for the year: Blende, 10,634; lead, 640 tons. Shipments for the week to separating plants, 1,339 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the April 6 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

Antimony Oxide, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the April 6 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.35.

NICKEL SILVER—34½c. per lb. for 18 per cent Grade A sheets.

YELLOW (MUNTZ) METAL — Dimension sheets 25c. per lb.; rods 22¼c. per lb.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the April 6 issue.

Rolled Metals

COPPER—Sheets, hot-rolled, 27¾c. per lb.; wire 19⅞c. per lb.

LEAD SHEETS—Full-rolled sheets 11c. per lb.; clipped sheets 11¼c. per lb.

ZINC SHEETS—10½c. per lb.

Monel Metal, and Nickel Sheets are unchanged from prices in the April 6 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of April 6.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $18.50; basic, $18; No. 2 foundry, $18.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $34; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended April 20, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	142¼	135⅛	138⅛	Mr.29,My.20 Q	1.75
Andes Copper	New York	54⅛	50⅛	52	Mr.29, My.6 Q	0.75
Arizona Com	Boston	4	3½	3⅝	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	126½	121⅛	125	Mr.7, Mr.25 Q	1.50
Calumet & Hecla	Boston	48	44⅛	46⅛	Fe. 28, Mr. 30 Q	1.00
Cerro de Pasco	New York	99⅛	96½	98⅛	Ap. 11, May 1 Q	1.50
Chile Copper	New York	103	98⅛	101½	Mr.22, Ap.22 Q	0.87½
Con. Coppermines	N. Y. Curb	14	12⅛	13⅛		
Copper Range	Boston	26½	25	25	Mr.15, Ap.15 Q	0.50
East Butte	Boston	4⅛	4	4	Dec., 1919	0.50
Granby Con	New York	91½	81⅛	83½	Ap.12, My.1 Q	1.75
Greene Cananea	New York	162⅛	155⅛	157½	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	72	68	69⅛	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	18⅛	18⅛	18⅛		
Inspiration	New York	51	48	48⅛	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	27½	25½	25½	Fe. 28, Mr.30 X	0.50
Kennecott	New York	86⅛	81⅛	83⅜	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	71	67½	69½	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	45½	42	44⅛	My1, My15 Q	1.00
Mohawk	Boston	58	55	57	Ap. 30, Je. 1 Q	1.50
Mother Lode	New York	4⅛	3⅞	4	De.14, De.31 SA	0.20
Nevada Con	New York	50⅛	46⅛	47⅞	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	43½	41⅛	43½	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	52⅜	50½	51⅛		
Ohio Copper	N. Y. Curb	2⅛	2⅛	2⅛	Sept., 1926	0.03
Old Dominion	Boston	14½	14	14⅛	Dec., 1918	1.00
Phelps Dodge, new	N. Y. Curb	74⅛	70⅛	71⅛		
Quincy	Boston	42⅛	39⅜	41⅛	March, 1920	1.00
Roan Antelope	N. Y. Curb	46½	43½	43½		
St. Mary's M. L.	Boston	37½	36½	36½	Fe.25, Mr.12	2.00
Seneca Copper	New York	7⅜	6⅞	7		
Shattuck Denn	N. Y. Curb	21⅛	19⅜	20½		
Sherritt-Gordon	Toronto	8.50	8.00	8.20		
Tenn. C. & C.	New York	18⅛	16⅞	18⅛	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	19	18⅛	18⅛	Ap. 4, My. 1 Q	1.00
Utah Copper	New York	310	310	310	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	2.00	1.60	2.00		
Walker Mining	Salt Lake	3.90	3.75	3.75		
Wenden Copper	N. Y. Curb	1⅛	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	3	2⅞	2⅞		
Amer. Z. L. & S.	New York	36⅛	35	36½	May, 1917	1.00
A. Z. L. & S., pfd.	New York	99⅛	96	98	Nov., 1920	1.50
Bingham Mines	Boston	....	....	55⅛	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	....	....	145	Mr.28, Ap.5 X	0.75
Butte Cop. & Zn.	New York	8	6½	7½		
Butte Cop. Con.	Boston Curb	*62	*55	*57		
Butte & Sup.	New York	8⅛	8⅛	8⅛	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld.	New York	2⅛	2⅛	2⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.50	3.50	3.50	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	13⅛	11⅞	13	Ap.5, Ap.10	0.25
Constitution	Spokane	*35	*25	*25		
Dayrock	Spokane	2.30	2.25	2.25	Mr.23, Mr.30	0.03
Dickens Consol	Spokane	*7⅜	*4	*5		
Eagle-Picher	Cincinnati	....	....	18⅜	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd.	Cincinnati	....	....	102	Jan. 15 Q	1.50
Erupcion	Boston Curb	....	....	*24	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	1.07½	*92	*95		
Eureka Lilly	Salt Lake	....	....	1.42½		
Eureka Standard	Salt Lake	5.00	5.00	5.00		
Evans-Wallower	N. Y. Curb	16½	14⅛	15		
Evans-Wal., pfd.	N. Y. Curb	....	....	81⅛	Mr.20, Ap.1 Q	1.75
Federal M. & S.	New York	....	....	245	Je., 1927	10.00
Fed. M. & S., pfd.	New York	99½	98⅛	98⅛	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*12½	*12	*12		
Golconda	Spokane	1.52	1.36	1.46	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*50	*43½	*47		
Hecla Mining	N. Y. Curb	18⅛	17	17⅛	My.15, Je.15 Q	0.25
Highland-Surprise	Spokane	*16½	*16	*16½		
Jack Waite	Spokane	*12½	*11	*11		
Kootenay Florence	Spokane	*15½	*14	*14½		
Lucky Jim	Spokane	*15½	*15	*15		
Lucky Tiger-C.	Kansas City	5⅛	5⅛	5⅛	De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.59	1.56	1.59		
National Lead	New York	153	146	146	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	140⅛	140	140	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb	330	330	330	Ap.20, My. 10 Q	2.00
N. J. Zinc, new	N. Y. Curb	84⅛	82⅛	84		
New Quincy	Salt Lake	2.75	2.50	2.55	My.15, My.27 I	0.10
Noble Five	Spokane	*68	*61	*64		
North Lily	Salt Lake	8.25	7.90	8.00	Jan. 20 Q	0.25
Park Bingham	Salt Lake	10	9⅛	9⅛		
Park Utah	New York	10⅛	10⅛	10⅛	Mr. 19, Ap. 10 Q	0.20
Pend Oreille	Spokane	9.50	6.00	6.75		
Rico Argentine	Salt Lake	42	41⅛	41⅛	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*40	*38	*40		
St. Joseph Lead	New York	69⅛	67	67⅛	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*36½	*34	*35		
Silver King Coa.	Salt Lake	14.62½	14.50	14.50	Mr. 20, Ap. 1 Q,	0.25
Silversmith	Spokane	*18	*14	*14	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	1.88	1.75	1.75	De. 20, BM	0.02
Tamarack-Custer	Spokane	76	72½	75	Sept., 1924	0.25
Tintic Standard	Salt Lake	16.25	14.62½	14.62½	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	....	....	*2½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	14.00	13.00	13.50		
United Zinc Smg	N. Y. Curb	1⅛	1	1		
Utah Apex	Boston	5	5	5	May 15, June 1	0.25
Utah Met. & Tun.	Boston	....	....	1⅛	Dec., 1917	0.30
Whitewater	Spokane	1.05	1.00	1.00		
Yellow Pine	Los Angeles	*20	*18	*18	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	6⅛	6⅛	6⅛		
Barry-Hollinger	Toronto	*35	*32	*32		
Central Manitoba	Toronto	*55	*52	*55		
Coniaurum	Toronto	....	....	*45		
Cresson Consol.	N. Y. Curb	*82	*77	*80	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	10	9⅛	9⅛	Mr.30, Ap..20 Q	0.25
Golden Cycle	Col. Springs	†1.63	1.60	.....	Fe.15, Mr.1	0.04
Gold Hill	Toronto	*5	*4	*4		
Hollinger	Toronto	7.40	7.00	7.10	Ap.5, Ap.22 M	0.05
Homestake	New York	73⅛	73⅛	73⅛	Ap.20, Ap.25 M	0.50
Kirkland Lake	Toronto.	1.13	1.05	1.06		
Lake Shore	Toronto	27.60	26.25	26.75	Mr.1, Mr.15 Q	0.20
McIntyre-Porc.	New York	....	....	19	My.1, Je.1 Q	0.25
Portland	Colo.Springs	†*9½	†*8	.....	April, 1927	0.02
Rand Mines	New York	....	....	*35	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*68	*63	*65		
Sylvanite	Toronto	1.75	1.55	1.75		
Teck-Hughes	Toronto	9.45	9.15	9.15	Ap. 7,My 1, O	0.15
Tom Reed	Los Angeles	*30	*30	*30	Dec., 1926	0.02
Unity Gold	N. Y. Curbs	2⅛	1⅛	2⅛		
Vipond Consol.	Toronto	1.12	1.08	1.11	April, 1927	0.03
Wright-Hargreaves	Toronto	2.25	1.80	1.85	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	17	16	17		
Castle-Trethewey	Toronto	*34	*34	*34		
Consol. Cortes	N. Y. Curb	....	....	*18		
Dolores Esperanza	N. Y. Curb	1⅛	1⅛	1⅛	July, 1923	0.05
Keeley	Toronto	*43	*40	*40	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.70	4.50	4.50	De.14,De.31 SA	0.15
Montana-Idaho	Spokane	*12½	*11	*12		
N. Y. & Hond. Ros.	N. Y. Curb	....	....	18	Ap.17,Ap.27 QX	0.05
Nipissing	N. Y. Curb	2⅛	2⅛	2⅛	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	2	1⅞	1⅞	Mr.14, Ap.4	0.06
Tonopah Exten.	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	....	....	2⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	....	....	*85		
Yukon Gold	N. Y. Curb	*77	*77	*77	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	117½	109½	117½	Fe. 15, R	1.00
Beth. Steel, pfd, 7%.	New York	119½	117⅛	119½	Mr.4, Ap.1 Q	1.75
Cleveland-Cliffs	Cleveland	....	....	200	Ap.15, Ap.25 Q	1.00
Colo. Fuel & Iron	New York	68½	63½	67⅞		
Colorado F. & I., pfd.	New York	....	....	133	Fe.11, Fe.25 Q	2.00
Great Northern Iron.	New York	31	30⅛	30⅛	Dec.15, K	2.00
Inland Steel	New York	93	91	92	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S.	New York	100⅛	92⅛	99	My. 11, Je. 1, Q	1.00
Republic I. & S., pfd.	New York	115	110½	115	Je.12, Jl. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	116½	108	115	Mr. 11, Mr. 20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	....	....	108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	189½	182⅛	186	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd.	New York	143½	143	143⅛	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C.	New York	....	....	23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	....	....	45	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	191½	168	186⅛		
Alum.Co.of Amer., pf.	N. Y. Curb	107	105½	106½	Mr.15, Ap.1, Q	1.50
American Metal	New York	61⅞	59	59	Fe.9, Mr.1 Q	0.75
Amer. Metal, pfd., 6%	New York	119	118	119	Fe.9, Mr.1, Q	1.50
Amer. Sm. & Ref.	New York	104	100½	100⅛	Ap .12,My 1,Q	1.00
Amer. & Sm. Ref., pfd.	New York	136¼	136	136	My. 3, Ju. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	39	38	38⅛		
Asbestos Corp.	Montreal	13	11½	12	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	40	35	40	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	440	410	420	De.31,Ja.15,SA	X6.25
De Beers Consol.	New York	25	25	25	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	35	33½	35	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	47⅛	44⅛	45	Ap. 5, My. 1 Q	1.00
Int. Nickel Can.	New York	49⅛	46⅛	47⅛	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd.	New York	....	....	121	Ap.2,My.1No.1Q	1.75
Newmont	N. Y. Curb	203½	197½	200½	Mr.30, Ap.15 Q	1.00
Patiño M. & E.	New York	41⅛	38⅛	38⅛	Ap. 20, Ap. 30	4m
So. America G. & P.	N. Y. Curb	2⅛	2⅛	2⅛		
Texas Gulf Sulphur	New York	85½	80⅛	83½	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M.	New York	60⅛	59	58⅛	Ap. 4, Ap. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	53	52	52⅛	Ap. 4, Ap. 15 Q	0.87½
Vanadium Corp.	New York	98⅛	92⅛	96	Fe.1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books: the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED APRIL 9, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—	Nov., 1926	4 p.c.(d)
Alaska Treadwell (25)	60/—	60/—	60/—	Feb. 1929	5 p.c.(c)
Aramayo Mines (25 frs.)	68/1½	66/6	66/6	Feb. 1929	5 p.c.(c)
Burma Corp (10 rupees)	18/1½	16/10½	17/—	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	21/3	18/8	19/9		
Camp Bird (2s)	2/9	2/6	2/7½	April, 1928	16⅔ p.c.
El Oro (£1)	4/10½	4/6	4/9	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	9/—	9/—	9/—	Jan., 1929	3½ p.c.
International Nickel of Canada (no par value)	$52¼	$48	$48	Mar., 1929	20(c)
Mexican Corpn. (£1)	13/1½	11/6	12/6		
Mexican Mines of El Oro (£1)	6/3	3/9	6/3	Dec., 1926	3½ p.c.*
Mount Isa (£)	48/9	46/10½	47/6		
N'Changa Copper Mining. (£1)	98/9	80/—	82/6		
Oroville Dredging (4s)	3/—	2/6	2/9	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	163/9	152/6	152/6		
St. John del Rey (£1)	16/1½	12/6	15/6	Dec., 1928	2½ p.c.
San Francisco Mines (10s)	37/9	35/—	36/3	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	10/6	9/6	10/—	Jan, 1929	7½ p.c.
Selukwe (2s. 6d.)	7/9	6/7½	7/3	April, 1917	6⅔ p.c.
S. Amer. Copper (2s.)	3/1½	2/7½	2/9	Nov. 1917	75 p.c.
Tanganyika (£1)	70/7½	63/9	64/6	July, 1928	5 p.c.
Union Miniere de Haut-Katanga (Brussels)	12,675	12,015	12,015	July, 1928	182.60 fr.(6)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.

(Price quoted in dollars with a fixed rate of $5 to the £1)